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Farm Telephony.

Comment on the possibilities of telephonic development outlined by us last week in a brief note, brings out a point of interest. We assumed that on the basis of the figures of Boston and of the exchanges in Sweden and Norway, there might well be in this country from 1,250,000 to 3,000,000 telephone subscribers instead of 750,000. The criticism made by a friend is that such a calculation is based on urban data, and that the figures of city population do not apply to a whole country. But the facts run the other way. It is true that city population is a large user of the telephone, but there are 4,500,000 farms in the United States, and if one tendency is specially marked in telephonic progress it is the determination of the rural people to get the advantages of telephone service. To them the telephone is in reality far more useful than it is to the dweller in the city, with messengers and cars at instant call. Fence wire telephony is already popular, but is only a step towards the time when perhaps every American farm may have its telephone putting it in touch with remote neighbors and the distant outside world.

The Nernst Lamp.

The two preponderating factors in the economy of illumination by incandescence are the temperature of incandescence and the radiating property of the incandescent body. The amount of light emitted rises rapidly as incandescence is increased, in the case of the carbon filament varying almost as the cube of the energy supplied. It is also known that the character of the radiating body plays an important part, a surface of magnesium, for example, radiating much more light for a given expenditure of energy than a surface of carbon. It appears, moreover, that the limit of economy for the carbon filament with the best commercial regulation is reached at about 2.5 watts per candle-power. These considerations have in the past led to many attempts to displace the carbon filament of the incandescent lamp by another material which can be used at a higher incandescence, or which has higher specific radiation.

Of the the work in this field that of Professor Nernst is the first which, when submitted to reliable and extended test, has given promise for the future. On another page we print an account of the principles of the Nernst lamp, as contained in the American patent, just issued as we go to press. This patent is evidently a preliminary one, covering the principles at issue, and any criticisms as to the practicability of the lamp would, therefore, be out of place. Owing to the comparatively large surface of radiation involved in the principle of the lamp, and the consequent considerable candle-power implied, it appears probable that the lamp will not prove a formidable rival to the present incandescent lamp, even if the great claims as to its superior economy be fulfilled. Nor are these claims for economy so high as to cause it to be looked upon as a rival to the arc lamp, unless the superior quality of the light emitted should prove a strong factor. In fact, at the present moment, it would seem that the lamp when perfected and its commercial practicability established, will fit

neatly into the unfillled gap between the present arc and incandescent lamps, and thus become another adjunct for existing circuits.

THE GENERAL ELECTRIC REPORT.

A few weeks ago the banks created a semi-panic in the stock market by taking joint action to reject practically all "industrial" stocks offered as collateral. Their ground for such a proceeding was that nobody except an insider could tell what an industrial was really worth. The railways and the telegraphs gave, they said, a pretty full account of their operations, their liabilities and the status of their business; but as for the industrials, it was all guesswork. Senator Depew followed up this pertinent criticism by urging that the banks should, and in fact did, constitute themselves public auditors, and that by refusing to advance money on securities whose underlying assets were unknown, they restricted trade and finance within safe limits. He urged further that the State should see to it that industrial corporations seeking a public market for their securities should give full publicity to their condition.

While commending heartily this general attitude toward untried and immature securities, we take some satisfaction in pointing out the fact that no industrials publish as full reports as do the Western Union, American Bell Telephone, and General Electric Companies —three typical electrical "industrials," each a leader, in its own field. This week we are enabled to present the figures of the General Electric Company, from a report filling no fewer than 27 pages. Every item in the report is gone into with care and particularity, and the whole balance sheet of the year is minutely analysed for purposes of explanation as well as checked by expert accountants. Such a report is a model for industrials.

Taking up the figures of the report, it is easy to see that the company by cutting in two its inflated capital has by that very act of courage brought itself once more up to the proper point of stability and dividend earning. The deficit of over $11,000,000 has been converted into a credit balance and nobody can object. That four millions could be dropped in offhand fashion from the Patents item in a single year, indicates that it was only kept intact in bad years for the purposes of a trim balance sheet. It will be noted that the Company's sales have been large and growing, and that the securities it has sold have not been used to swell apparent profits but appear still as solid assets in the enlargement and betterment of the manufacturing plant.

THE METRIC SYSTEM.

In our editorial columns, last week, we called attention to the fact that every industry in the English-speaking countries is hampered by the perplexities of the existing tables of weights and measures. There are signs, however, of rebellion against the iron glove of arithmetical bondage and a spirit of awakening is at hand. For years efforts have been made in Congress to introduce legislation looking towards a gradual introduction of the metric system. At the present time, we have arrived thus far, that the metric system may be legally used in the country, and that the standard of length recognized by government is the distance between certain marks upon a bar of metal preserved in Paris and which is the Standard International Metre. A commentary upon the condition of affairs is found in the fact that government engineers and geodetical surveyors compute all their observations in the metric system and finally reduce the result to feet and miles for the benefit of the vernacular; that every modern scientific book or publication of any prominence or standing employs the metric system; chemistry, physics and all the exact science have assumed the garb of metric expression, and if physiology and materia medica are still behind the van in this respect, it is solely because they are yet but inexact sciences. In all good modern schools the metric system is taught, thus paving the way for the transition that must sooner or later come about, when the sense of the ridiculous upon this question has been sufficiently awakened in the community at large.

It is doubtful if any set of tables of weights and measures could have designedly prepared more elaborately confused than those which we possess as our heritage from the time-honored creations of barbarous and uncivilized usages. There was a time not so many centuries ago, when all arithmetical computations, in the then civilized world were performed in Roman numerals. Imagine the difficulty of multiplying the numbers; say MDCCCXCIX and LXVIII. It is hard to imagine, at the present time, how the process was conducted or how much time it occupied. It remained for the Arabs to introduce the metric system of numerals and to enable 1899 to be multiplied by 68 in the way we ordinarily execute the process. Yet this radical improvement which revolutionized the numerics of that day is scarcely more beneficent to the engineer than would be the change from the common to the metric system of measures, and we are informed by historians that the change from the arithmetic of the Roman numerals to the arithmetic of the Arabic numerals was only brought about in the face of vehement opposition on the part of numerous teachers and scribes; partly because the new system rendered the use of the abacus or counting machine unnecessary, and people were so accustomed to carrying about the abacus in order to execute the computations of the multiplication table.

The introduction of the metric system would be of especial use to the electrical fraternity, because it would enable the fundamental physical relations of things to be more readily grasped, since the labor which now has to be expended by the student in arranging and co-ordinating his ideas of magnitude, so arduous a task in the elementary stage of the work, would be entirely removed from his path. Any school boy from the continent of Europe has less work to grasp the fundamental principles of engineering than his compeer in an English-speaking country, by reason of the tact that he has the magnitudes all presented to him in a simple, coherent form. Although it may be granted that all mental labor is in some manner remunerative, the labor which would be saved to the student by an adoption of the metric system could be utilized in some manner bringing him more immediate and valuable return.

ELECTRIC RAILWAY RETURN CIRCUIT.

Attention has recently been called in our columns to the importance of reducing, as far as possible, the differences of electric potential between different portions of an electric railway track system. When an electric railway is situated in the open country, so that its sphere of influence is remote from buried metallic pipes, all imperfections in the return system of conductors are paid for and supported entirely by the railway corporation. If there is a heavy drop of pressure between the track and the return bus-bar in the station, that fact can only mean a lowered plant efficiency, and an increased fuel consumption per car mile. If, owing to such differences of potential as present themselves, electrolytic corrosion of the rails is developed, that fact can only reduce the life-time, and increase the renewal cost of the permanent way. Electric railways, however, naturally grow and flourish in large cities and crowded communities, and only pursue a desultory and checkered existence in the open country air. In the large cities, buried metallic pipes abound. They form convenient conductors, and their owners would probably have no objection to their use for the conduction of railway electric currents, provided that these currents were only carried along them and did not pass into or out of their lateral surfaces. The currents that pass along a buried water pipe are in almost all cases harmless, while the currents that pass into or out of

such pipes through the surrounding soil are always accompanied by some electrolytic action. However small the electrolytic action may be, it can only be a question of time when the electrolytic corrosion will develop to a serious extent.

Every year makes it more clearly evident that the earth cannot be depended upon to carry powerful electric currents. Telephonists tried it and have largely given it up. Electric light men tried it and have given it up entirely. Electric railway men have tried it to their cost, and to the cost of their friends, and they had better give it up completely. The telegraphists are the only electrical men who continue in calm and undisturbed possession of the earth return. An ideal street-railway system would not employ even the street rails as part of their conducting system, and still less the ground. The underground trolley systems possess this advantage, but the overhead trolley system must at least use the rails as conductors. An ideal trolley system would, therefore, employ the rails as main conductors in connection with a complete return feeder system, arranged like the main and feeders of an electric light system, in which a potential difference between any points on the mains cannot exceed a certain limit. Only when the track system forms part of a properly designed and installed system of electric feeders and mains, can the evils of electrolytic corrosion be absolutely prevented in an overhead single trolley system having its rails lying on the ground. In some cases the return-feeder system need not be insulated in order to reduce the difference of potential between any pair of grounded points to the requisite limit. In most cases, however, there is a decided advantage in employing insulated return feeders.

The importance of this matter has for some time been particularly emphasized in Great Britain, where it has paid to employ insulated return feeders on the score of economy in first cost, owing to the stringency of the rule of the British Board of Trade to the effect that if an uninsulated ground return be employed, the maximum drop occurring in it must not exceed 7 volts. It is, of course, theoretically possible to have all of the track at the same potential, although a considerable difference of potential might exist between it and a return bus-bar at the station, provided that sufficiently numerous insulated track feeders are employed, and, as was pointed out in our editorial columns recently, the use of a comparatively small number of feeders or sub-feeders may frequently enable the track difference of potential to be reduced to an insignificantly small amount. Such a trolley system would have a set of insulated feeders supplying the trolley wire which would be practically all at the same potential, and another set of insulated feeders supplying the track, which would also be practically all at the same potential, while there would be a practically constant working difference of potential between the trolley wire and the track.

High Voltage Generators vs. Step-Up Transformers.

In the design of long distance transmission plants using the highest voltages now considered practicable—from 20,000 to 30,000 volts—there is no doubt of the necessity of generating the electric power at a comparatively low pressure and raising it with step-up transformers to the line voltage, but for plants using 10,000 to 12,000 volts there is a sharp division of practice. There will be found on other pages a description of an interesting little plant transmitting power to Portland, Maine. Here, although the machines are only of 250 kw output each, the full line pressure of 10,000 volts is generated in their windings.

The advantage of the high tension lies, of course, in the saving of the first cost of the station transformers and in the increased efficiency of the system due to the elimination of their losses. The first cost of the transformers is, in the large sizes which are always used for this purpose, only about $5.00 per horse power, and the depreciation, attendance charges and repair accounts of such transformers are very small. The losses on average load amount to about 2 or 3 per cent. of the power transmitted, the maximum efficiency of such transformers in units of several hundred kilowatts capacity being over 98 per cent. By generating the power at full pressure there is, therefore, a saving of, say, 2½ per cent. of the power and of 60 to 70 cents per horse power year in the fixed charges and maintenance account of the station.

The high voltage in the machine slots has several disadvantages to offset these gains. The coils must be insulated from the iron of the machine with great care, not only on account of the high voltage generated in them, but because of the fact that there is no transformer insulation between them and the line, and lightning is hence more likely to start a breakdown. On this account the insulation must have a certain minimum thickness, and wherever there is a break in its continuity, must show a large distance between the copper and iron or discharges will creep over it. To obtain this thickness and distance would completely fill with insulation the slots of machines as ordinarily wound for lower pressures, leaving no room at all for copper. To obtain a proper ratio of cross section of copper to cross section of slot, the latter must be of large size. This limits the distribution of the winding and practically brings it down to one slot per pole per phase in all machines except very large ones with high peripheral speed and low frequency. With comparatively high frequencies, such as 60 cycles, and low peripheral speeds, giving crowded poles and teeth, it is practically impossible to obtain the high voltage in any way whatever, as there is no room for even one slot per pole per phase with the required insulation and any proper amount of copper. It is interesting to note, however, that in this respect the two-phase machine is somewhat superior to the three-phase, as the former requires only two slots per pole and the latter requires three per pole, where, as usual, the windings of all phases are carried under all the poles of the machine.

This limitation of the space occupied by the copper, combined with its covering in a thick wrapping of insulation, limits as a rule the rating of the machine considerably below what might be obtained with the same iron and a winding designed for a lower voltage, so that the saving in the cost of transformers is partially, and in extreme cases may be wholly, taken up in the increased cost of the generators. Besides this, the limiting of the distribution brings in all the disadvantages of the unitooth or pole-wound type—the tufting of the lines of force, the consequent increased iron losses, the distortion of the wave form, the increase of the self-inductance, etc.

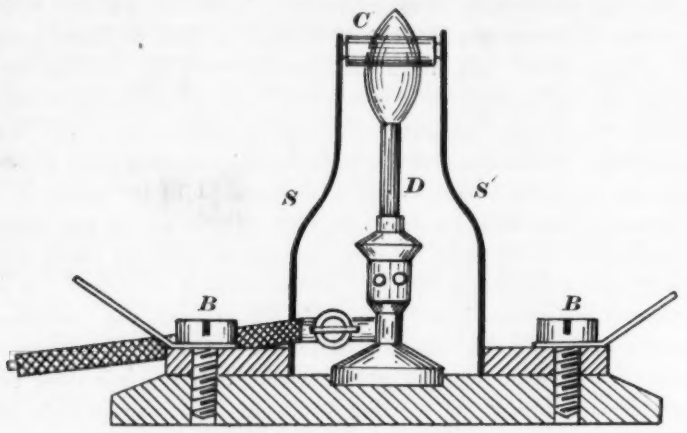
Wherever there is any likelihood that increased voltage may become desirable, the direct generation of high pressures is not to be advocated. With step-up transformers it is a simple matter to change from 10,000 to 20,000 volts if it ever becomes desirable to reduce the line loss 75 per cent. by this step, and with increasing knowledge of the diminishing difficulties of high pressures, this is a very probable contingency. The transformer has, so to speak, but one great slot per phase for its magnetic circuit, the insulation of which is easy compared with that of the many slots of the machine, so that transformers which are insulated for 20,000 volts can be bought at practically no greater cost than those for 10,000 volts, and can be worked at the latter pressure and changed to the higher one at any time without difficulty. With machines this is not the case, as the added insulation for the higher pressure would not only considerably increase the cost, but also increase the disadvantages mentioned above.

The American Nernst Lamp Patent.

THE American patent on the Nernst lamp (No. 623,811), was issued April 25, 1899, the date of application being October 2, 1897. The inventor is Walther Nernst, and the patent is assigned to George Westinghouse.

The specification states that the inventor has found that certain of the dry conductors of the second class or dry electrolytes—that is to say, materials which, when in a conducting condition, conduct current by electrolytic action—will, when heated to an incandescence under suitable conditions, become sufficiently conducting under moderate electrical pressures to permit the passage of sufficient electric current to maintain them at incandescence, and that the light given off thereby may be much greater per unit of electrical energy than is secured from electric conductors of the first class.

It is possible, for example, to bring such substances as lime, magnesia, zirconia and other of the rare earths, which are examples of dry electrolytes, to a conducting condition by the application of external heat, such, for instance, as may be obtained from an alcohol lamp or a gas flame, and it traversed by an electric current while in such heated condition, they will be brought to an intense white heat and maintained in that condition, by the passage of the current. They, moreover, have the capacity of withstanding these very high temperatures, even while exposed to the open air, so that



A FORM OF NERNST LAMP.

exhausted receptacles or those filled with poorly conducting gases are not necessary, although permissible with the present invention.

As an example, the inventor states that, by external means, he has heated in the open air, a small hollow cylinder of burnt magnesia of 7 millimeters length and 1.5 millimeters thickness to a conducting temperature, and with a current of less than one-third of an ampere at 118 volts pressure (39.3 watts) obtained a light much greater than that of the present commercial 16-cp incandescent lamp.

The new form of lamp is stated to be capable of being operated by either alternating or continuous currents, but the former have, for some purposes, been found more desirable, as usually the lamp will endure longer under the influence of an alternating than of a continuous current.

As the materials referred to are essentially insulators at ordinary temperatures, they must be brought to a comparatively high temperature before they will begin to act as conductors, but when they are brought to a conducting condition and current is permitted to traverse them, their temperature and incandescence is still further increased and their resistance lowered. The external heat may be withdrawn when the light-giving body has itself become sufficiently conducting to convey the current, but in some cases it may be desirable to continue the external heat also.

Referring to the Jablochkoff suggestion of heating a kaolin strip or plate placed between two conductors, by means of the electric spark of an induction coil, whereby one part or line of the kaolin plate or strip will become a conductor of a very high resistance, it is stated that this method is not capable of commercial use and differs from the Nernst method and the lamp embodying the same, in the fact, among others, that kaolin is easily melted; that the Nernst illuminant is primarily brought to a conducting temperature throughout and not along merely a line or portion thereof; and that the Nernst form of lamp permits the use of currents of much lower pressure.

In another patent (U. S. Patent No. 322,033) it is proposed to heat a small section of the length of a strip of refractory material, by contact with the tip of a carbon pencil heated by the passage of an electric current, and, as the pencil dissipates, establish a current through it and the heated section of the refractory strip. This form of construction, the inventor states, differs from his among other things, in being much more complicated and uncertain in its results, and in being dependent upon the shifting of a movable contact between the heating body and the illuminant, which involves an irregular and imperfect contact and undue resistance and diminishes the economy and durability of the lamp, and, moreover, the contact of the heated carbon with the heated strip will quickly reduce and disintegrate the latter.

The accompanying illustration illustrates one method of employing the invention of the patent. *A* represents a base carrying two binding posts *B, B*. The binding posts are respectively designed to be connected with the conductors of a suitable electric circuit supplied with the desired pressure, say 100 or 200 volts. Greater or less electrical pressures may, however, be employed. Conductors *S* and *S* are connected with the respective binding posts *B*. Between the conductors *S* there is mounted the light-giving body *C* which is here shown as consisting of a small bar, rod or cylinder and is composed of such dry electrolyte or rare earth as described above. The conductors *S* may be elastic if desired so as not to subject the body *C* to undue strains.

For the purpose of heating the light-giving body *C* to the proper temperature for rendering it conductive under the influence of the electrical pressure to which it is subjected, the flame of a lamp *D* may be used. Any other suitable device may be employed for applying the initial external heat, but it should be noted that the initial heat must be imparted by means separated from the body *C*, since any material placed in actual contact with the dry electrolyte *C* will either itself be composed or driven off by the intense heat developed when that body is traversed by an electric current, or result in a reduction or disintegration of the electrolyte composing the light-giving body. The claims of the patent are as follows:

1. An improved electrical incandescent lamp, consisting of a strip of material which is an insulator at ordinary temperatures and becomes a good conductor and luminant at high temperatures, combined at its extremities with fixed terminals for conducting current through the same, and with a heat producing structure separate from the luminant and operating to raise all parts of the strip between the fixed terminals to a conducting temperature prior to the passage of the illuminating current, substantially as described.

2. The method of producing light by the passage of an electric current through a strip of material which is a non-conductor at ordinary temperatures, but becomes a good conductor and luminant at high temperatures, which consists in heating the same throughout by a source of heat separated from the luminant, until it becomes a good conductor, and then maintaining its conductivity and luminosity by the passage of an electric current, substantially as described.

3. An electric lamp consisting of a current carrying strip of material which is an insulator at ordinary temperatures and relatively good conductor at an incandescence temperature, and heating apparatus separated therefrom and arranged to heat the strip to a conducting temperature throughout its entire section.

Mr. Croker's Municipal Gas-Plant Scheme in Disfavor.

At Albany, on April 20, Mr. Croker's scheme to have the legislature direct New York City to establish a municipal gas plant was practically killed in the Senate. The question came before the Senate on a motion to discharge the Cities Committee from the further consideration of the measure.

Senator Stranahan said he was surprised that the city authorities should propose to bond the city for $30,000,000 to build a city gas plant, when for the past eight years the city authorities had been claiming that the city's bonded indebtedness was so near the constitutional limit that it could not expend $50,000,000 to build an underground rapid transit road. He asserted that rapid transit was demanded by the people of New York City, while the only sentiment in favor of a municipal gas plant was that manufactured by Mr. Croker and his political leaders with their own organization. It was purely a political and not a business proposition.

Power Transmission Plant in the Maine Woods.

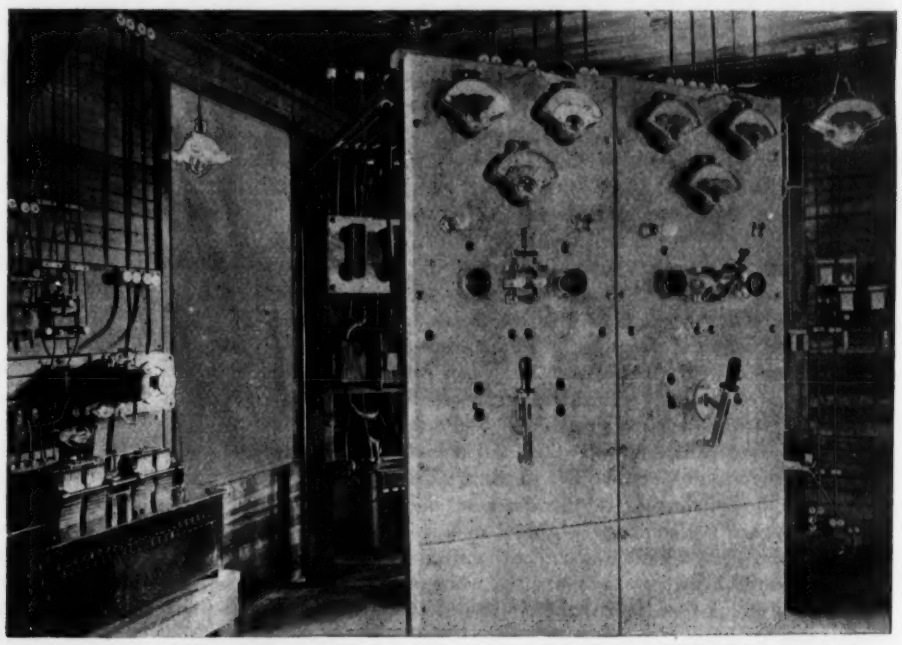
IN the Maine woods back of the city of Portland lies Sebago Lake, well known to many sportsmen, who in summer find a line of steamers running on it and tributary waters, and furnishing a convenient route to fishing and hunting resorts inland. The lake is at an elevation of 270 feet above tidewater, and is drained by the Presumpscot River, which stream has many falls and rapids in its sixteen miles of length, partially utilized for some years by the usual saw mills, grist mills, pulp mills, and other power absorbing works commonly found in country villages.

The Presumpscot Power Company has built at the outlet of the lake a cut stone masonry dam which impounds the water up to a maximum level nine feet above the normal lake surface, and over an area of about ninety-seven square miles. This storage is made to equalize the flow in the river which otherwise varies from a maximum of about seventy thousand cubic feet per minute during the spring melting to a minimum of about forty thousand feet during the summer droughts. An idea of this storage can be obtained from the fact that the city of Portland is supplied with water from the lake, and takes 6,000,000 gallons per day, which mount would lower the level of the lake only 1½ inches per annum if it received no supply during that period.

A corporation known as the Sebago Power Company owns the rights to a large part of the valuable water powers above referred to, and proposes to eventually utilize them on an extensive scale by generating electric power in considerable quantities and transmitting it to Portland. In the meantime, an allied or sub-company was formed by a stockholder of the Sebago Power Company, Mr. Geo. W. Brown, which built and is now operating the preliminary plant described below. The sub-company, of which Mr. Brown is president and manager, is known as the Cumberland Illuminating Company, and pays the parent company $500 per year for the rights to 3000-hp, with the understanding that its property will be bought by the parent company when the latter wishes to operate.

The power house is located in the village of Great Falls, about two and a half miles below the outlet of the lake. Here there existed a log dam giving a head of 22 feet, once used by a paper mill, now abandoned. This dam with gates, forebay, flume, wheel pit and foundations, is utilized temporarily by the electric company, its plans providing, however, for a higher dam which will give an available fall of 36 feet.

The turbine equipment consists of eight Hercules wheels with sealed draft tubes submerged in a timber penstock. These wheels, which are rated at an aggregate output of 750-hp under the present head, are arranged in four pairs on two horizontal shafts, two pairs per shaft, and are controlled by a governor for each shaft.



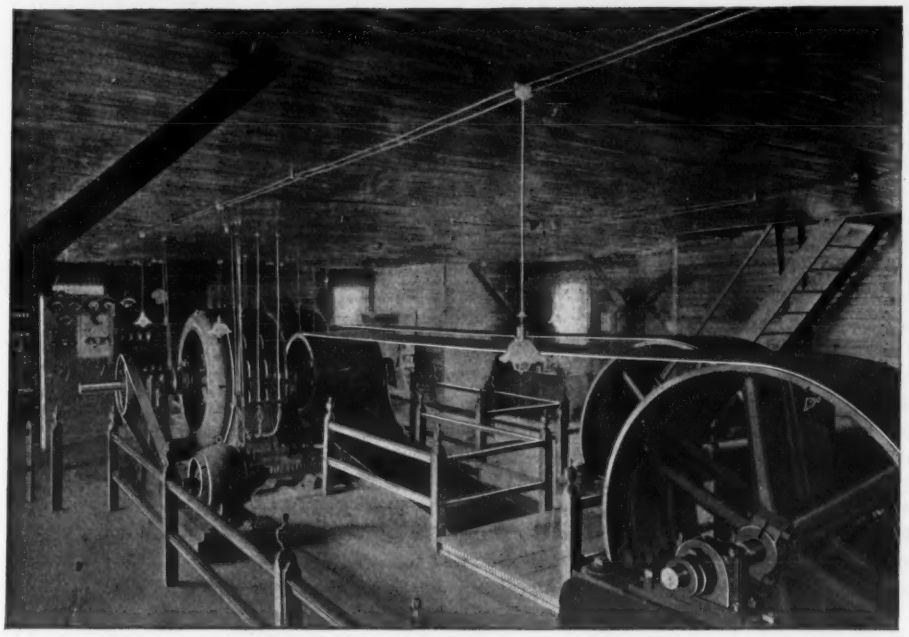


Fig. 1—Pole Line.
Fig. 2—Power House.
Fig. 3—Switchboard.
Fig. 4—Tail Race.

Electric Power Transmission Plant of Cumberland Illuminating Company, Portland, Me.

The two shafts extend through the bulkhead into the dynamo room, and are directly belted, through 38-in. belts, to the two dynamos, respectively. This arrangement was chosen instead of direct-coupled sets partly on account of the proposed change of head, which will run the wheels at a higher speed. By properly changing the pulleys the same dynamos can be continued in service. The two generators are 3-bearing revolving field machines, rated at 250-kw each, and possessing the usual features of the General Electric Company's designs. The machines have sixteen poles and run at a speed of 450 r. p. m., therefore giving a frequency of 60 cycles per second. Their most interesting peculiarity is the fact that they generate the full line pressure of 10,000 volts, three-phase, directly in their armature windings, and thereby do away with the need of step-up transformers. Owing to this high pressure the armature winding is not distributed, there being only one tooth per pole and per phase.

The three belt-tightening rails under each machine are mounted directly on the concrete foundations, eight feet deep, thus giving the iron of the machines a good ground, doing away with any risks of shock from the frame, and throwing the whole duty of insulation from ground on the dielectric within the slots. The shaft of the machine is extended on the end opposite the pulley, as is also the base of the machine below it, so that the armature and pillow block at this end may be slipped along to expose the armature windings for renewal or repairs. Two small jackscrews are fitted to each machine by which the armature and bearing pedestal may be pushed along.

The switchboard of blue marble stands diagonally across one corner of the room, giving ample room and the light from two windows behind it. Owing to the dampness it was inadvisable to run the wires below the floor, and to avoid the unsightliness of a lot of high-tension wiring overhead, the leads are carried through the ceiling, and all horizontal runs made in the attic.

The measuring instruments on each of the two panels of the board are as follows: One a.c. voltmeter, one a.c. ammeter in one leg of the machine leads, and one d.c. voltmeter in the field circuit. All of these instruments are of the same type—the inclined coil—giving the board a neater appearance than those in which the direct-current instrument is of a different type. The custom of providing for measurements on all three phases has not been followed, as there is an ammeter in only one leg, and the voltmeter cannot be transferred from phase to phase. A small double-pole two-way switch throws the secondary terminals of the potential transformer in one position to the voltmeter, and in the other to the phasing lamps in series with the potential transformer of the other machine when its switch is similarly placed. Each panel contains also a field switch of the type in which the knives before opening the circuit, enter clips shunting the field winding with a non-inductive resistance. The main switch is of the oil-break type, and is the only point on the board getting the high tension current, the instruments all getting derived currents. Each exciter is independently wired to the field of its own machine, there being no provision for paralleling the exciters or supplying both fields from either of them. A bracketed d.c. voltmeter is connected to receptacles by which it can be plugged to either exciter.

Behind the board are six expulsion-type fuses connected in the machine leads, and the current and potential transformers for the instruments. The latter transformers are fitted in their 10,000-volt sides with fine fuses enclosed in asbestos tubes surrounded in turn by glass tubes. The one set of bus-bars is connected directly to line without switches, fuses or other apparatus, except Wirt short-gap lightning arresters.

A piece of apparatus of particular value in transmission plants is a Chapman automatic voltage regulator, which promptly compensates for any irregularities in speed due to the inherent irregularities of water-wheel governing. It is also fitted with a series winding connected directly in one leg of the outgoing line for over-compounding the machines for the line drop. Owing to the difference of phase between the potential transformer and the current in this outgoing leg, the regulator also compensates for the inductive drop due to lagging currents, or the inductive rise due to leading currents, should they occur. The regulator is specially made with two resi tances and commutators, both operated by the same solenoid and connected respectively in the field circuits of the two machines, so that both are controlled together when working in multiple.

The high tension line is 14 miles in length, and follows the public highway, which is unusually straight the whole distance to Portland. The poles are set 100 fee: apart, are guyed on curves with a Brooklyn strain insulator in each guy wire and carry each a standard four-pin crossarm, on three pins of which the No. 2 wires are strung without a single transposition or spiralling. Double petticoat green glass insulators guaranteed for 20,000 volts are used. A telephone line, transposed on every sixth pole, is bracketed to the poles a couple of feet below the crossarm. There are no line arresters or other lightning protective devices along the line, although it is anticipated that they may be found necessary, in which case they will be put in.

On account of the large number of trees set out along the road side, considerable cutting and trimming has been necessary, but this has been limited as far as possible. Where twigs or branches have come in contact with the wires, the trouble has promptly cured itself by the burning off of the branch without any serious effect on either line or operation. Wherever the line crosses a highway or any other overhead wires, an ingenious method of protecting against possible disaster in case the high tension wires break, has been adopted. Three steel wires have been strung immediately above the three line wires and attached to special insulators each side of the crossing. At intervals of a few feet each line wire passes through a spilt porcelain break or spool which is supported from the steel wire above. This construction, which is shown in the foreground of Fig. 1, has several obvious advantages over the guard net customarily used.

The present transformer house is a small temporary wooden structure, equipped with four General Electric 75-kw air-insulated, forced-draft transformers, stepping down from 10,000 to 2080 volts. They are supplied with air by a Buffalo forge blower driven by a 1-hp induction motor. At present they are connected in pairs in what might be called the V-grouping on both primaries and secondaries—that is, across two phases of the line with no transformer in the third phase. This naturally increases greatly the copper losses per transformer, but shows the possibility of emergency working in this way when one transformer of a delta-connected group is crippled.

The plant is in continuous operation with the aim of building up a day-load of motors. At present its evening peak only amounts to about 100-hp, but its officers have signed contracts for $20,000 worth of business, which will undoubtedly be 50 per cent. greater as soon as its lines are extended to the business centre of Portland from the outlying districts which they now reach. Its rates are far lower than those given by the older company before the competition began, being as follows: A meter rate of ten cents per kw-hour for lights and a flat rate or contract rate of $4.50 to $8 each per light. Both these rates are subject to a discount of 10 per cent. and a further discount of 10 per cent. more to stockholders. The rates for power are also only about one-half those charged by the steam plant.

The corporation law enacted by the state legislature in 1895 provides that no company can obtain the rights to operate an electric lighting system without the consent of its rivals already in the field, except by a special act of the legislature. On this account the new company found it necessary to purchase the charters and privileges of the Portland Electric Light Company, the Deering Electric Light Company and of the Cumberland Illuminating Company, the name of which it assumed. Its progress has been persistently resisted by the Consolidated Electric Light Company of Portland, which is now lighting the city from a steam-driven plant, and this opposition is trying to prevent the new company from obtaining the rights to place pole and conduit lines in the city proper, but it is expected that these rights will soon be secured.

The new company is capitalized at $100,000, of which $60,000 has been issued and about $50,000 expended in construction work. No bonds have been issued. Its plant has been in operation since Nov. 4, 1898.

Fence Wire Telephony in Kansas.

A few months ago the ranchmen of Seward County, Kan., met to propose a plan of connecting their ranches by telephone facilities, utilizing the barb-wire fences instead of setting poles and stringing wires. It had been demonstrated that a fence wire worked perfectly for a telephone connection. The scheme was favored by the stockmen, and a local company was formed, with headquarters at Liberal, that being the nearest telegraph point.

Lines have since been constructed and are in operation, extending from Liberal over the whole of Seward, Stevens, and Morton counties, Kansas, and have reached out into Beaver County, Oklahoma, and Hansford County, Texas. Many of the ranches in this ideal grazing country are situated miles from railroad and telegraph facilities.

Secondary Distributing Systems for Three-Phase Plants.

By Aug. J. Bowie, Jr.

IT is generally recognized, where lighting is at all heavy, that transformers with secondary mains are much more economical than an individual transformer system. In general, anywhere from 25 per cent. to 70 per cent. transformer capacity can be saved by putting several customers on the same transformer, and not having to supply capacity for all connected lights, as would be necessary in the case of individual transformers.

Among the advantages of the use of a secondary system, is the greater safety, due to not running the high tension wires around indiscriminately, the convenience in connections and disconnections and the economy in the cost of the same, in the cost of transformers and in the efficiency of the transformers themselves due to their larger size.

To offset these advantages, there is the cost of secondary mains, besides the additional drop in the same. A secondary main system may be easily carried to excess, by the use of too large secondary wire, by attempting to feed too far, or by bad judgement in the location of transformers or mains. In many places will be found wire as large as No. 00 where No. 4 wire would have been of ample size.

It is evidently of first importance, to have the voltage drop in the secondaries small. A maximum drop of 2 per cent. will give good results and is generally permissible.

Having decided to put up such a system, the first point to be decided is the manner in which the secondary shall be run. There are six different system practicable, each of which has its advantages and disadvantages. They are as follows:

1. Two-wire system. 2. Edison three-wire system. 3. Three-phase delta with two transformers. 4. Three-phase delta with three transformers. 5. Three-phase "Y" with three transformers. 6. Three-phase "Y" with two transformers, one leg being left out.

1. *Two-wire.*—This should be used only when the distance fed is short or the lighting is not heavy. No balancing is required, of course, so that this is the simplest of all the systems.

2. *Edison three-wire.*—This is about the best system of all for general use, as it gives almost as good efficiency of copper as the "Y" connection, and is also much easier to balance. For residence lighting in particular, it is especially fitted.

3. *Three-phase delta, two transformers.*—This system gives very poor use of secondary copper. Lights should not be connected across the legs where there is no transformer, since the drop due to current in the transformers drawn from this phase is excessive, and if the three phases were equally loaded with non-inductive loads, only 87 per cent. of the transformer capacity, would be available. Provided the two phases with the transformers alone were equally loaded, the common leg would carry $\sqrt{3}\times$ the current in each of the other legs.

4. *Three-phase delta, three transformers.*—This likewise gives very poor economy of secondary wire. For best use lights should be connected equally on the three legs. One good point about this system is that if the load is not balanced, the three transformers help each other out.

5. *Three-phase "Y", three transformers.*—This system has the advantage of the highest efficiency in the use of secondary wire, but the transformers are entirely independent and cannot help each other out. However, if the primary fuse of one transformer were to blow, it would put out only the lights connected to it.

6. *Three-phase "Y", two transformers—one leg being left out.*—This system is the same as No. 3 except that the secondary of one of the transformers is reversed. It has an advantage over No. 3 in the much better use of the secondary copper. With a balanced load the current in the neutral is just equal to the current in each of the legs. If the lines and the load be practically non-inductive, then for small secondary losses, the volts drop $= 1\frac{1}{2}\times$ volts drop in the case of the Edison three-wire system. It has the additional advantage of balancing the primary loads on a line on two phases.

While it may seem that No. 5 will give the best results in so far as balancing the primary load is concerned, yet in general, suitable balance may be easily obtained by balancing the different transformers on the different phases independently of the secondary system. It is one thing to work out a three-phase "Y" system on paper, but it is quite another thing to balance it properly in practice, where all kinds of wiring are encountered, and where even if by any chance the lights in a building should happen to balance in number, yet they may be arranged so that in the ordinary course of events, none of the different legs will burn at the same time. Moreover, there is quite a difference between balancing on two legs (as in the case of an Edison three-wire system), and balancing on three legs. Still, there are often places where a three-phase four-wire system is a good thing, for downtown lighting, especially, since small three-phase motors may be put on the mains in addition to the lighting business, provided the system be large enough not to let them affect the voltage appreciably. Also if the lighting is very thick, suitable balance may be obtained without difficulty.

It would, however, be well, in case any large lighting were to be installed, to have the wiring done, either by the company or under their supervision. This, unfortunately, is often not possible. Systems Nos. 3, 4 and 5 will allow the use of three-phase motors, without additional transformers. As a general rule, however, it is best to provide separate transformers for the lighting and power, as the loads usually overlap in the winter, making the service bad. For residence lighting the Edison three-wire is preferable to all other systems, not only because it is easier to balance than the "Y" system, but also because all the transformers can be combined into one.

Balancing.—The subject of proper balancing of secondaries is one which is often overlooked. There seems to be a kind of hap-hazard method of putting the lights on, and letting the system take care of itself. For example, the writer has seen one transformer with an Edison three-wire secondary (running in two directions from the transformer), where all the lights in one direction were on one leg, and those in the other direction on the other leg—the wires without taps evidently being there for the sake of appearance. In another case with an Edison three-wire, there were 250 lights on one leg, and 47 lights on the other leg, and the primary current into the transformer, showed that the transformer was somewhat overloaded.

In order to balance the lights on any secondary system, there should be provided some form of block book, so that one can work intelligently. Account should be kept of the location of the lights, the legs on which they are, and of the probable time of burning the lights. It is unnecessary to go too much into detail about the last mentioned subject, but one should have a good idea about it, and the work of this sort should be in charge of some one familiar with the lighting of the places in question. In places where more than two wires are run in, account should be kept of the number and class of lights on each leg, and these places should not be passed by as balanced, because all the legs happen to run in. Also, it is not necessary to run all the legs into one place, unless the lighting be large enough to justify it, as it is often well to balance different places against each other. In one case which the writer recalls, four wires of a three-phase "Y" system ran into one store where there were 21 lights on one leg, 15 lights on another leg, and only one light on the third leg. This had been supposed to be balanced. The main point to be aimed at in balancing, is to do so for full load; but it is also well to keep some kind of a balance at other times. With a block book, this is not a difficult thing to obtain. When such a book is once properly made out, it requires very little trouble to keep it up, and it soon pays for its existence.

In the controversy between single-phase and three-phase systems, undue stress is often laid on the difficulty of properly balancing the latter. With a plant of any size, this difficulty is largely imaginary, if only a reasonable amount of care is used. In balancing a three-phase system, it is well to begin at the end of each of the primary branches, and to balance the transformers going in; and also balance the totals as well as possible on the mains from which the branches go. In this manner the best possible use can be made of the primary wire. Thus there is an advantage of saving 25 per cent. of the copper in the mains and branches, over either single-phase or two-phase. If some of the branches are not long, and the lighting is not very heavy, it is unnecessary, of course, to run more than two primary wires.

In order to show how closely it is possible to balance a three-phase system by the methods mentioned, in one station with which the writer was connected, the output of one high-tension lighting panel was about 175 amperes per leg at 1000 volts. The system was balanced without any reference to the ammeter readings, account only being taken of the transformer capacities at the different locations. The result was that the three ammeters read within 2 per cent. of each other at full load. This was as closely as they could be depended on, being station instruments.

As far as keeping a system balanced is concerned, it is not a difficult task, for if a transformer is to be changed to another leg, all that is necessary is to change one of the primary wires.

The accompanying table shows the relative weights of wire for

COMPARISON OF DISTRIBUTING SYSTEMS.

System.	Weight of Wire.
1. Two-wire	100
2. Edison Three-wire	37½
3. Three-phase delta, two transformers	93¾
4. Three-phase delta, three transformers	75
5. Three-phase star, three transformers	33⅓
6. Three-phase star, two transformers (one leg not connected)	56¼

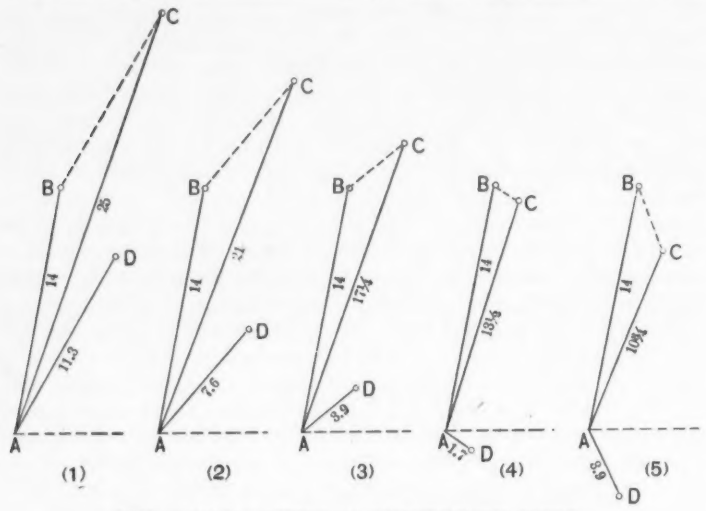
the same efficiency, in the six secondary systems discussed. All wires in use in any one system are supposed to be the same size.

Action of a Synchronous Motor as an Inductance and as a Condenser.

BY PROF. A. F. MCKISSICK.

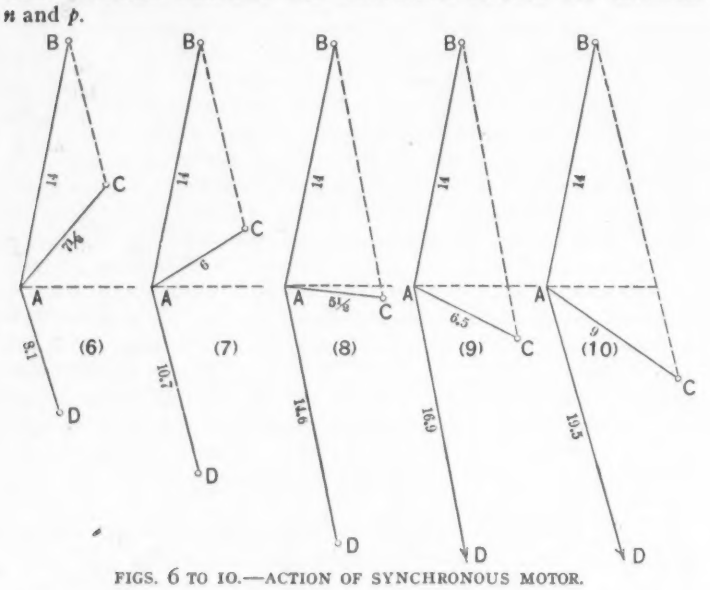
THE following experiment was undertaken with the idea of showing the inductive and condenser actions of a synchronous motor, whose field strength could be varied.

In the diagram of connections, *A*, *B* and *C* represent ammeters, *D*



FIGS. 1 TO 5.—ACTION OF SYNCHRONOUS MOTOR.

the synchronous motor, and *E* an inductive resistance of constant value (a single-phase induction motor running empty). A constant potential difference was maintained between the terminals *n* and *p*.



FIGS. 6 TO 10.—ACTION OF SYNCHRONOUS MOTOR.

The experiment consisted in varying the field strength of *D* and reading the corresponding values of *A*, *B* and *C*.

The results are shown plotted in Figs. 1-10.

The position of the current *C* with reference to the impressed potential difference was found by means of a wattmeter. In the diagrams this current is represented by *AB*, whose value is 14 amperes and cosine of angle of lag .19.

The positions of the total current *A*, represented by *AC* in the diagrams, and the current *B* (to the synchronous motor), represented by *AD*, were found by completing the triangle as shown, and drawing *AD* in its proper position.

In Fig. 1, we have the field exciting current of the synchronous motor the least, which is gradually increased to a maximum in Fig. 10.

In Fig. 1 we have all the currents lagging behind the impressed potential difference, and their value large.

In Fig. 2, the angle of lag of *AD* is lessened (due to increased field exciting current of synchronous motor), and its magnitude

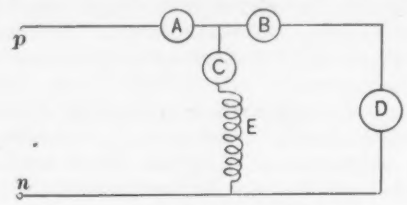


FIG. 11.—DIAGRAM OF CONNECTIONS.

diminished, and as the result *AC* is changed in value and position as shown.

In Fig. 3, we see this effect increased, and in Fig. 4 *AD* becomes a leading current (the synchronous motor now acting as a condenser), reducing still further the value and lag angle of *AC*.

In Figs. 5, 6 and 7, we have a still further reduction of the magnitude and lag angle of *AC*, and in Fig. 8 we have this lag angle changed to a lead angle, the total current being very small.

In Figs. 9 and 10, we have this lead angle increasing and also the value of the current increasing.

The Track Circuit.

BY C. C. ANTHONY.

PROBABLY nothing ever devised for the purpose of bringing railroad signal and interlocking appliances under the automatic control of trains is so simple and effective as the track circuit. In America, where it was invented, it is now in use on several thousand miles of track; as yet, however, its advantages do not seem to be fully appreciated in other countries. It consists simply of the two lines of rails of a portion of track separated from the adjoining rails by insulating rail joints, with the poles of a battery connected to the opposite rails at one end, and the coils of an electromagnet at the other. It has, however, certain peculiarities, and the proper relation of its parts involves some slightly complicated considerations. The "line" resistance, being that of railroad rails, is, of course, very low; the insulation resistance is also very low and variable—so low as to be an important factor in the proportioning of the battery and the electromagnet and its coil resistance; and the current in the magnet coils is cut off by shunting, when the rails are connected by the wheels and axles of a train, and not by opening the circuit. With the low insulation and shunt resistances it is impracticable to use a high potential or large current. It follows that the track circuit must control electric signal appliances indirectly through a comparatively delicate relay.

Several measurements recently made give various rail resistances from less than .1 ohm on a circuit 2400 feet long to .5 ohm on 4500 feet; these are the total resistances of the two lines of 30 ft., 85 lb. rails—4800 and 9000 feet. The varying resistances of the rail joints, in multiple with the bond wires, must have a considerable effect and might easily offset differences in length of circuit and weight of rail. Insulation resistances from 10 to 42 ohms were found in dry winter weather—the former on a circuit 4500 feet long with gravel ballast, the latter on stone ballast and a length of circuit of 3300 feet. The insulation resistance is not often as low as 2 ohms in wet weather on such sections of well ballasted, well drained track. There is no doubt, however, that the condition and material of the cross-ties have an important effect. On two parallel circuits exactly alike, except that on one there were old oak ties, many of them considerably rotted, and on the other comparatively new hard pine ties, the insulation resistances were, for the first, a little over 2 ohms and for the second, nearly 9 ohms.

The track circuit may conveniently be regarded as consisting of

three parts: The battery end, composed of the battery, battery leads and the rails on half of the circuit, the whole resistance of which may be called the battery resistance; the relay end, composed of the rails on the other half of the circuit, the relay leads and the relay coils; and the insulation, which may be taken as a single resistance, in multiple with the relay, connecting the rails at the middle point of the circuit. Besides these resistances, we have to consider the energy required for the secure working of the relay; the electromotive-force of the battery; the shunt current —that is, the current delivered by the battery when the track is short-circuited, which must be kept within reasonable limits; and the shunt resistance. Since the energy used in the coils of an electromagnet to produce a given result is practically independent of the size of wire used for the winding, if a satisfactory relay has been designed and is found to take a certain fraction of a watt when it attracts its armature promptly, the arrangements of battery and resistances for various conditions must be such that this amount of energy shall be available at the relay coils under the most unfavorable circumstances assumed. It is commonly assumed, and no doubt rightly enough, that the wheels and axles of a train make a practically perfect electrical connection between the rails. Nevertheless experience goes to show that this connection is sometimes not perfect, but has, on account of sand, rust, etc., on the rails, some considerable resistance; in very rare cases this resistance has been sufficient to prevent effective shunting of the relay.

If E represents the E. M. F. of the battery;

r_b, battery resistance as defined;
r_i, insulation resistance;
r_l, resistance of relay leads;
r_r, relay resistance;
r_s, shunt resistance;
I, current delivered by battery;
i, current received by relay;
w, energy required by relay;

$$I = \frac{E}{r_b + \frac{r_i\,(r_r + r_l)}{r_i + r_r + r_l}} \quad (I) \qquad i = \sqrt{\frac{w}{r_r}} \quad (II) \qquad i = I\,\frac{r_i}{r_i + r_r + r_l} \quad (III)$$

$$I = \frac{\sqrt{\frac{w}{r_r}}\,(r_i + r_r + r_l)}{r_i} = \frac{E}{r_b + \frac{r_i\,(r_r + r_l)}{r_i + r_r + r_i}} \quad (IV).$$

If a certain type and arrangement of battery is to be used and a certain minimum insulation resistance is to be provided for, the energy required by the relay being known, the proper resistance for the relay coils is given by the following formula, which is obained by solving equation (IV) for r_r:

$$r_r = \pm\sqrt{\left[\left(\frac{2\,w\,(r_b + r_i)\,(r_b\,r_i + r_b\,r_l + r_i\,r_l) - E^2\,r_i^2}{2\,w\,(r_b + r_i)^2}\right)^2 - \left(\frac{r_b\,r_i + r_b\,r_l + r_i\,r_l}{r_b + r_i}\right)^2\right]} - \frac{2\,w\,(r_b + r_i)\,(r_b\,r_i + r_b\,r_l + r_i\,r_l) - E^2\,r_i^2}{2\,w\,(r_b + r_i)^2}.$$

The minimum e. m. f. must be taken unless the effect of variations is covered by equivalent internal resistance, and the maximum internal resistance, together with the resistance of the longtest leads likely to be required must be included in r With the gravity battery at least it is well to allow a margin for increased polarization on short circuit; the battery takes a little time to recover after the passage of a train and the relay may be slow in closing if conditions become so bad that it gets barely sufficient current for working. In eleven sets of readings on various track circuits the highest battery resistance found, not including half the rail resistance, was 1.6 ohms. In all cases there were two cells of gravity battery in multiple; the leads were copper, in most cases No 9. B. & S., and in a few cases No. 12, with lengths from 100 to possibly 300 feet of wire. The e. m. f. was assumed at its maximum, 1.1 volts. The value of w will depend upon the design of the relay; for some relays in common use it is about .036. Of the two values given by the formula the larger would be the one to use; the smaller relay resistance, although meeting the conditions, would not only require a larger current, but would be less favorable for the shunt.

The battery resistance to be used with given relays and a battery of low internal resistance, such as a storage battery, is given by the formula:

$$r_b = \frac{E\,r_i - i\,r_i\,(r_r + r_l)}{i\,(r_i + r_r + r_l)},$$

obtained from equations (II) and (IV). The resistance to be inserted would be the difference between r_b and the battery lead resistance.

It has already been remarked that the shunt may have some resistance which may even be so great that opening of the relay will not be effected. While hand cars commonly fail to maintain effective shunts, close observation of the working of automatic signals indicates that, with the heavier rolling stock used in trains, failures to open track relays almost never occur. But as every failure of an automatic signal or other device to give the proper protection to a train, however infrequent such failures may be, is a very serious matter, the parts of the track circuit should be so arranged that the relay, while not failing to close under given unfavorable conditions, shall open with as high a shunt resistance as possible. To this end two things are necessary. The relay itself must be as sensitive as possible to a small reduction of current, that is, it must release its armature when the current is reduced a small amount below the minimum working current; and the resistances and e. m. f. in the circuit must be so proportioned that the application of a given shunt resistance shall reduce the relay current as much as possible.

Since the addition of a given shunt resistance to the circuit will have the same effect as the reduction of the insulation resistance to the joint resistance of itself and the shunt resistance, it is sufficient to consider what arrangement of resistances and e. m. f. will cause the greatest change in the relay current to result from a given change in the insulation resistance. The current flowing through the relay is given by the formula:

$$i = \frac{E}{r_b + r_r + r_l + \frac{r_b\,(r_r + r_l)}{r_i}},$$

obtained from equations (I) and (III). The effect of a given shunt resistance is found by substituting for r_i in the formula the joint resistance of r_s and r_i, the latter taken at a maximum or fairly high value. It is evident that, for a given type and arrangement of battery, the relay resistance should be as high as possible, and that for a given relay the battery resistance should be as high as possible. It is also true that, the relay remaining the same, a high e. m. f. with the proper high battery resistance makes the shunt more effective than a low e. m. f. and low battery resistance.

When the gravity battery is employed it is convenient to use two cells in multiple as far as possible. It is then proper to make the relay resistance as high as the maximum battery resistance combined with the minimum insulation resistance will allow. Storage battery, with its high voltage and the high battery resistance that can be used with it, provides for much higher shunt resistances than those that are effective with the gravity battery; at the same time high relay resistance, although the battery resistance must be somewhat lower, gives better results in the matter of shunting than low resistance. The limit, however, seems to be about 10 ohms or less. When the e. m. f., as well as the internal resistance, is low, as in battery of the Lalande type, only a small resistance can be inserted with a single cell; a strict regard for safe working would make it desirable to use two cells, in series, with a larger resistance.

To make the relay sensitive it is important, for one thing, that the magnetization should not go very high. In addition it seems quite desirable that the air gap be rather large and the movement of the armature as small as possible. Aside from these conditions for sensitiveness, it may be noted, as pretty well settled, that the weight of the armature and its attachments, with a vertical movement, should alone be depended upon to draw the armature from the magnet; a spring may break or its tension may change. The magnet cores should be large, to give a low magnetization, and long, to make room or a large number of turns of wire with a given resistance.

To state the requirements of the track circuit briefly: The relay should be sensitive and efficient. When such a relay has been designed the relay or battery resistance, whichever one of them is to be determined in a particular case, should be as high as it can be made with due regard to the necessary provision for the

closing of the relay under the most unfavorable conditions expected; when both are matters of choice a comparatively high relay resistance is advantageous. Any possible small economy of current that might be secured by a particular arrangement is quite subordinate to the effectiveness of the shunt. So, too, a maximum of energy at the relay from a given battery is not an essential requirement; if the required amount of energy is available under the most unfavorable conditions nothing more is necessary. On the other hand, waste of current on the shunted circuit must be kept within reasonable limits; but the considerable battery resistance required for this purpose is equally useful in making the shunt effective.

A Note on the Wehnelt Interrupter.

BY R. H. CUNNINGHAM, M. D.

IN Mr. Swindon's remarks on the Wehnelt electrolytic interrupter as reported in a recent number of *Nature*, March 16, 1899, I notice it is stated that the interrupter will not begin acting if the circuit be closed by bringing the platinum anode into contact with the acid electrolyte. Such a statement, however, is but partly correct in my experience with the apparatus, and only holds good when a *slow* closure of the circuit is made in that manner.

If the platinum anode, either in the form of a single wire, or in the form of a short loop, be *plunged* quickly into the electrolyte, the characteristic action begins at once, and just as if the circuit had been closed suddenly in the usual manner by a metallic switch. Furthermore, with a moderate sized condenser also attached to the terminals of the interrupter the action will begin also if the anode be plunged suddenly into the electrolyte.

The so-called fatigued condition that often develops when the apparatus is subjected to a continuous usage for half an hour or more is also readily remedied by removing the anode, pouring out the mercury and then carefully heating the projecting platinum wire for a moment to redness in a small pointed flame. In doing this, naturally, care must be taken not to break the glass. Before reinserting the restored anode into the electrolyte it is well to see that the latter is cold, for if it be hot the glass tube containing the cold mercury is almost invariably cracked at the seal.

Very often the surface of the lead cathode becomes extensively covered with numerous tenaciously adherent bubbles of gas after constant usage, which increase the resistance of the apparatus very considerably. Vigorous joggling of the lead plate will help matters greatly under such circumstances.

One very great inconvenience in the use of the interrupter is the constant tendency of the electrolyte to become boiling hot very quickly. After experiencing considerable trouble in this respect with all the various forms recommended by Wehnelt and by Thompson, and finding that in spite of the glass jar or the lead vessel being surrounded by water, the electrolyte became soon so hot that the action of the apparatus ceased, I employed a lead cathode made of about twenty-five feet of small lead pipe (⅛ in.) coiled in the form of a rectangular spiral and contained along with the electrolyte and platinum anode in a thin walled hard rubber jar with a flat top. Both ends of the pipe protrude several inches above the top and are connected by rubber tubes to two large bottles. The rubber jar is placed in a pan of water containing ice; one bottle is filled with crushed ice and water and the other bottle catches the water after it has passed through the coil. Thus by alternately elevating and depressing the bottles the iced water may be made to flow from one bottle to the other *via* the lead coil in the electrolyte. Or, if no harm would result from the slight grounding that occurs, the lead coil may be connected by rubber tubes to the faucet and the waste of a convenient sink.

Street Railway Strikers Sent to Jail.

The employes of one of the street railway companies in Wheeling, W. Va., had been on a strike for some time. Four of them were tried on the charge of obstructing the operation of the road and each was sentenced to thirty days in jail and fined $50. The employes of the railway company struck to secure an advance in their wages.

On the Dimensioning of Field Magnets.

BY GEORGE T. HANCHETT.

In direct-current dynamo construction the armature is usually the first member to be designed, and when the problem of designing the field magnet is encountered certain requirements and conditions are already established.

These may be briefly enumerated as follows: First, the density in the field magnet is determined by the necessary total flux, the coefficient of leakage and the material of which the field magnet is to be made. Second, the area of the magnet waist is determined from the total flux and the density. Third, a known number of ampere turns, comprising those necessary to force the flux through the gap space and through the armature, must be placed on the field magnet. Fourth, an additional number of ampere turns are necessary to force the flux through the field magnet itself. These are unknown, and depend on the length of the magnetic circuit, which is also unknown. We therefore have the following problem to solve, namely: To determine a length for the magnetic circuit which shall be sufficient to accommodate coils which give the necessary ampere turns without overheating, and at the outset we do not know what the necessary ampere turns are.

The usual method of procedure is to make a scientific guess at the total ampere turns, and from them to calculate a length of magnet sufficient to accommodate a properly designed coil that will produce them. It may develop that the field magnet so designed will require more magnetizing force than that which was allotted to it, in which case a second guess and calculation must be made.

On the other hand, if the ampere turns that the field frame requires is less than the number estimated, a smaller coil will answer, which gives opportunity to shorten the magnetic circuit and thereby reduce the weight of the machine and increase the economy of the field magnet. Two or three guesses, each aided by the previous estimate, solve the problem sufficiently approximately for practical work. The first guess is usually made on the basis that the total ampere turns are equal to twice the necessary ampere turns for the gap spaces, and this assumption usually gives a magnetic circuit that is too long.

The determination can be made with mathematical accuracy, and without involving the precarious element of scientific guess so extensively, in the following manner:

Let a represent the ampere turns necessary to force the flux through the armature and gap space.
b the ampere turns necessary for the pole pieces.
c the ampere turns necessary for the yoke.
x the ampere turns necessary for the magnet waists, unknown.

The total ampere turns, N, are then, $a + b + c + x = T$, or

$$k + x = T \qquad (1)$$

where $k = a + b + c$.

Let l = length of the magnet waists, unknown.
r = the depth of the winding.

Then $l\ r$ = the maximum area of copper circuit and of this value a percentage must be taken according to the thickness of insulation of the wire used.

The permissible ampere density in field magnets varies with the size of the wire and the depth of winding. It will be necessary to choose a value for the ampere density. This can, however, be easily determined with sufficient accuracy for the purpose. The error which would involve a sensible difference in temperature would be very large, and unlikely to occur. The available copper area can be determined as shown beyond.

If, then, p = the percentage of solid copper in the coil section and i = the current density, we have

$$N = r\ l\ p\ i \qquad (2)$$

The ampere turns per inch of length of magnet waist can be readily determined by ordinary methods, and if this be represented by n, we have

$$x = l\ n \quad (3).$$

Combining equations 1, 2, 3, we have,

$$N = k + l\ n = r\ l\ p\ i,$$

$$\text{whence } l = \frac{k}{r\ p\ i - n;}$$

and all the quantities in the right-hand side of the equation are known quantities and readily determined.

The application of this formula in practice is very simple, and is readily made.

Suppose that we have a field magnet length to determine for a 1-kw machine. Suppose that *a*, *b* and *c* have been determined at 900, 100 and 300, and that the ampere turns per inch of length is found to be 10. If the machine is shunt-wound, and the armature is to operate at 120 volts, the size of the field wire will be between No. 20 and No. 28 B & S; we will say No. 25. Let the permissible winding depth be 2 inches. This quantity is usually determined by the dimensions already fixed.

The ratio of wire section, insulated, to winding space is .7854, whatever the diameter of the wire. If d be the diameter of the insulated wire and d' the diameter of bare wire, it is plain that the ratio of wire section to copper section is

$$\frac{d^2}{d'^2}$$

from which it is readily deduced that in a winding space of dimensions r by l we have an available copper space of

$$r\,l\,p = \frac{.7854\ r\ l\ d}{d'^2}$$

$$\text{whence } p = \frac{7854\ d'^2}{d^2}$$

Thus, if the field bobbin is to be wound with No. 25 wire, double cotton-covered, the value of p becomes

$$p = \frac{.7854 \times .0179^2}{.027^2} = .345.$$

The only quantity left to determine is l, and practice has shown that it is not wise to have this exceed 1000 amperes to the square inch, and any designer of a line of dynamos will soon construct a table of advisable current densities for the particular type on which he is engaged. Assuming the value of 1000, the formula for the length becomes:

$$l = \frac{1300}{2 \times .345 \times 1000 - 10} = 2 \text{ inches nearly.}$$

It is interesting to note that these figures were approximated from the dimensions of a small iron-clad bipolar motor, which used just such thin, flat coils as these results dictate.

Electrolysis as an Unsolved Municipal Problem.

A very interesting and suggestive paper was read last month before the Engineers' Club of Brooklyn, N. Y., by Mr. H. S. Wynkoop, M. E., on the subject of electrolysis as an unsolved municipal problem. This gentleman is well-known in connection with the work of the Bureau of Electricity and Gas of Brooklyn, and has long paid special attention to the question. He began with a historical review of the situation, showing how the telegraph and telephone interests had employed the ground return without protest and how they had come to assume that they alone among electrical industries had the right to do so. When the arc light came, the ground was not used, although there was trouble from leakage, and this was true again when the incandescent light came along. But when the trolley arrived, it was altogether different, and it was found that the two could not exist together "on earth." The telephone disputed the field, but was worsted, from the legal standpoint, as rehearsed by Mr. Wynkoop; whereupon began the modern telephonic era of metallic circuits and vastly improved service. The trolley was thus left in practical possession of the ground, but now new troubles came to light in the alleged damage done by straying current to water and other pipes. Reports on this subject date back to 1891 in Boston, and the matter ceasing to be a bone of contention among electrical corporations became a living issue for the consideration of municipal engineers.

Mr. Wynkoop gave in his paper an enumeration of some of the cases and of the remedies, down to about three years ago, and continued:

Thus matters stood until the summer of 1896, when the Board of Commissioners of Electrical Subway began a resurvey of the city. In a careful review of the facts up to date the writer had been struck by the absence of reports indicating damage to cast iron pipe. Three instances only were recorded: One, by J. H. Vail, of a 6-inch water main from a Pennsylvania town, eaten through in 2½ years. The material composing this pipe is not stated, but the photograph, as well as the inference, points to cast iron. The second, from a city west of the Mississippi, perhaps St. Louis, the inference as to cast iron being derived from the context of the report only. The third, from Memphis, Tenn., where the "burning out" of a 6-inch main is stated to have occurred. In this last instance the phraseology would seem to indicate that the electric arc, rather than slow corrosion, was responsible for the damage.

In view of these facts relative to cast iron, it was decided by the Subway Commission to devote a large portion of the work of the 1896 survey to an investigation of the condition of the Brooklyn water mains. The writer was detailed to represent the city on this work, Mr. John A. Barrett, acting, as in 1894, on behalf of the commission.

We selected more than a dozen localities where voltmeter readings had indicated that trouble might be expected, and with the aid of the pipe yard gang uncovered the pipes. Sample observations are as follows:

Hydrant at rear of New York and Brooklyn Bridge dock, just north of Fulton Ferry—positive to river, 1.4 to 2.2 volts; soil, sand and cinder, tide rising and falling through same; hydrant somewhat rusted; cast iron branch pipe slightly crusted with rust, the usual cinder scale on the under side in spots; indications only such as might have been expected to result without electric aid; hydrant and pipe placed about 1880.

Hydrant at foot of First Street, west of Gowanus Canal, positive to canal, 4 volts; soil, made ground; hydrant slightly rusted; adjacent wrought iron fittings badly eaten away; pipe, and hydrant placed Aug. 23, 1894.

In order to check in practice the conclusions of Stone and Webster, who had deduced from laboratory experiments made in Boston in 1894 that the jumping of electricity around the joint of a water main caused electrolytic action on the positive pipe, we uncovered, on Third Avenue, oposite the Nassau power house, a few lengths of 8-inch cast iron main, coated with tar. This pipe was manufactured by the Camden Iron Works, was cast in the old nine-foot lengths and had been in service since Nov. 17, 1868. For nearly three years a heavy current had been conducted along this pipe; and at the time of our test the voltmeter showed one volt difference of potential around each joint, or five volts in five lengths of pipe. In the absence of suitable appliances for indicating the current, rough calculations by several persons present fixed its value at from 1000 to 3000 amperes.

Four lengths of pipe, as they lay in the virgin sandy soil, were carefully inspected; and then a section, consisting of the bell and two feet of pipe on either side, was taken out intact, split in half longitudinally and the interior closely scrutinized. No pitting appeared, nor was it possible to detect by calipering any diminution in the thickness of the pipe on the plus side of the joint.

But the most remarkable feature of this pipe was the clean asphaltic covering, almost as fresh on this twenty-eight-year-old section as on the new 12-foot lengths that replaced it.

Mr. Barrett concisely stated the situation when he said: "From such an examination as we were able to make, it would be unwarrantable to assert broadly that cast iron of any particular quality possesses an absolute immunity from electrolysis. In fact, a test applied to a fragment of cast iron pipe in a tin pail of earth, with a drop of potential of 10 volts from the fragment to the pail gave in three weeks undoubted evidence of electrolysis of the iron. But from a careful investigation of the facts so far as we are able to proceed with it, I think it is at least safe to suggest that at low potentials cast iron, of such quality as exists in the water mains which were examined, will endure practically unharmed a flow of current into the earth, which, under the same conditions, is totally destructive to wrought iron and lead."

For two years this very cautious statement remained unchallenged, even though distorted by careless readers into a definite claim for the absolute safety of cast iron; and the Brooklyn officials charged with the distribution of our water supply experienced no leak in cast iron pipe that could in any way be laid at the door of electricity.

Last summer the sense of security that prevailed here was rudely disturbed by the astounding statement of the secretary of the Dayton (Ohio) Water Works, that, to repair the ravages caused by electricity on the water mains of his city, it would be necessary to replace 17,513 feet of cast iron mains, at a cost of $77,000.

The remedies that have been suggested may be enumerated as follows:

1. Better track return by means of heavier rails, larger bonds, return feeders. The remedy is being steadily applied. It is, however, a palliative, not a cure.

2. Bonding between rails and affected pipes—the intimate and general connecting together of rails, water pipes, gas pipes, subways and cable armors at the so-called danger points. This seems to be a perfect cure—in spots, that is to say, if on the first day of January this plan of bonding goes into effect, on the 1st of February an entirely new system of bonding is necessitated to take care of the new danger points that have resulted from the very steps taken on January 1 to effect a cure. Furthermore, there is considerable doubt as to how well the pipe joints will stand the increased flow of electricity due to this extensive bonding.

3. Auxiliary potential plan—an arrangement of dynamos and wiring by means of which the pipes, etc., are kept or supposed to be kept, negative to the rails at all points and at all times. These arrangements, of which there are many—mostly patented—may undoubtedly prove of service in smaller cities or towns, where the conditions are not as complicated as in Brooklyn.

4. The insertion of insulating sections into a line of pipe—usually this is proposed only for the water mains. Twelve-foot lengths of wooden water main placed in the line at intervals would greatly discourage the electricity in its attempt to get home by this path. An increased burden would in this way be thrown upon the gas pipes and other conductors; and more wood pipe would be required to take care of the increased evil in a new direction.

The Wyckoff wood pipe for a complete system of water distribution has been suggested as a remedy. This pipe seems to bear a good name in certain Western cities where it is in use. Still, however, desirable it might prove to be for extensions, one cannot expect that the present iron piping will be discarded for wood; and it is the existing piping that primarily concerns us. The writer has not been able to determine whether the apathy shown in certain quarters toward his suggestion of three years ago to experiment with a few services of Wyckoff pipe was due to a lack of interest in the subject, or to a thorough acquaintance with the demerits of the pipe.

It has also been suggested that the use of the present cast iron mains be retained, the electrical discontinuity of the line being attained by the insertion of an insulating washer at each joint and the use of cement or iron oxide for caulking, instead of lead.

It seems evident that in this fourth remedy the element of expense has been ignored. The plan proved desirable in the case of service renewals, however.

Experience in Brooklyn would indicate that a very hard, dense, even-grained while cast iron, containing alloyed, rather than combined, carbon, and coated with Dr. Smith's coal pitch varnish, or some of the asphaltic lacquers that have taken its place, is probably as secure against corrosion as any existing iron product. There is a field for research in this direction, however, in the discovery of a cast iron that will not be attacked by the acids set free by electric currents in the soil, and of a paint, varnish, lacquer or oxide coating that will absolutely protect the present grade of cast iron. This may sound visionary; but the experience of the underground cable people in protecting their lead armor against certain forms of decay by the addition of 3 per cent. of tin, indicates at least a possibility of similar success in the matter of cast iron.

Professor Samuel Sheldon, of the Polytechnic, is experimenting along this line, confining his attention more particularly to cast iron. The writer is keeping in close touch with these tests, and is confident that they will result in interesting discolsures.

New York Rapid Transit Underground.

Governor Roosevelt has sent a message to the New York Legislature on New York City rapid transit, in which he says: "It does not seem to me wise that a franchise of this nature should be given in perpetuity. It would, of course, be best to have it owned by the municipality; although I would point out to the advocates of municipal ownership that it is doubly incumbent upon them to take the most efficient means of rebukirg municipal corruption and of insisting upon a high standard of continuous fidelity to duty among municipal employees. Only if the government of the municipality is honest will it be possible ever to justify fully the workings of municipal ownership." The New York *Journal* claims to have secured subscriptions for $146,757,100 for the underground electric road. The color of the money is not stated.

Bipolar and Multipolar Construction.

By Alton D. Adams.

The aim here is not to compare relative advantages inherent in bipolar and multipolar design, but to point out certain features in which bipolar are inferior to multipolar dynamos as at present made. During some years after the inception of incandescent lighting and later electric power, the bipolar dynamo was almost the sole source of dynamic currents, and even to this day a large per cent. of electric light and power to the country over is supplied from old bipolar machines. Within the last few years, however, and particularly since 1893, the multipolar dynamo has steadily grown in general favor, until it has practically displaced the bipolar type for all new work requiring units larger than 50-hp, and also to a considerable extent in smaller sizes. There are, however, a number of makers who find a demand for bipolar machines and continue their manufacture in small and medium sizes .

In many cases the present construction of bipolar machines follows the same lines common for some years back, and it seems not improbable that the absence of improved constructions in these dynamos has been a large factor in their smaller use. Shortly after the introduction of multipolar dynamos for direct-current work there appeared in them two features of construction valuable alike to the manufacturer and the user; one of these was slotted or toothed armature cases, the other was internal passages for armature ventilation. Increased ventilation enabled the manufacturers to obtain greater activity and larger output per unit weight of material, within certain temperature limits, and toothed armature cases presented to the purchaser a more reliable and substantial construction, especially in machines of high voltage, subject to heavy overload.

Somewhat later came the very general introduction of the carbon brush on multipolar machines, and this last improvement has probably done more to influence purchasers than either of the other two. While the ventilated and slotted armature core and the carbon brush have each operated to decrease the cost or increase the desirability of the multipolar type, the bipolar has in most cases continued the same old machine, with a smooth, unventilated armature core, covered with successive layers of insulation, and overwound with cotton-covered wire connected to a commutator of insufficient area to permit the use of the carbon brush.

If the bipolar machine is to continue as a type for general use it now seems certain that it must come to embody those in proved constructions common in the multipolar type, and it, therefore, is of interest to inquire whether there is anything inherent in the bipolar machine to prevent the use of these improvements.

While considering the applications of above improvements to bipolar dynamos, it is well to consider the English practice, where more attention has been given to perfection of bipolar machines, and where they have held the market to a much greater extent than in this country. Ventilated armature cores, by means of spider mounting and radial openings, have long been standard practice in English bipolar construction, as has also the use of two or more independent windings on armatures connected to alternate bars of commutators.

In the matter of slotted armature cores there seems but little to learn from English practice, as there has been until quite recently here a decided preference for smooth-core construction in direct-current machines. As a result of English methods of armature ventilation a magnetic saturation of 80,000 to 100,000 webers per square inch of core section is there common, while from 50,000 to 70,000 webers per square inch is more common in this country.

The metallic brush has to a large extent maintained its place on English bipolar machines, but the multiple armature winding above mentioned has been introduced to aid sparkless commutation in machines of large capacity, as in a double winding, for instance, the current in each part to be reversed at the point of commutation is only one-half that in a single winding for the same capacity machine. Drawing a lesson from the above for the improvement of our own bipolar machines, it appears that taking armature cores of the present dimensions the necessary metal for slots and internal passages may in some cases be removed and still leave sufficient section of iron remaining, while in others but a small increase in diameter will be necessary, as the cooling effect of internal passages and the exposed ends of teeth more than offset the heat due to greater magnetic activity in the core.

The greater regularity and more exposed condition of end windings with toothed and ventilated cores also tend to a lower temperature of operation. As a net result, therefore, of the toothed and ventilated core construction applied to our bipolar armatures, their weight would be slightly reduced or remain the same, length could easily remain the same, and diameter the same, in some cases, and in others slightly increased.

A toothed armature construction is in no way less favorable for bipolar than multipolar machines, and in one particular is more easily provided for, as the air gap necessary for sparkless operation is longer in bipolar than in multipolar machines of the same capacity, so that the loss from heating of pole corners would be less in the bipolar machines for a given form of tooth and width of slot. The present weight of magnet windings in smooth core bipolar machines would not be materially changed, as about the present air gap resistance must be retained to insure sparkless commutation when slotted armatures are introduced. Weights of magnet windings remaining the same, no change in magnet frames would be necessary except in some cases a slightly increased armature bore, and the net weight of frame would remain the same.

In the size and construction of commutators proportioned for metallic brushes a considerable change is necessary to provide suitable contact area for carbon. Many of the older bipolar dynamos had commutators designed for a brush contact area of 100 to 125 amperes per square inch, while the allowance for carbon brush contacts has gradually increased until at present 30 amperes per square inch of carbon brush contact with commutator is considered about the desirable amount.

How to secure above greatly increased contact area on bipolar commutators is a question admitting of several solutions. The commutator may be greatly increased in length, but this entails a large expense for commutator, brush fixtures and increased length of armature shaft and dynamo base. Again, the width of commutator bars may be sufficiently increased to provide the necessary area, with the present length, with but slight increase of cost, or when armature and air gap relations permit of a reduction in the number of segments the cost may be somewhat reduced.

The last and best expedient in machines of fairly large capacity is to maintain the external dimensions of commutator about the same as for the metallic brush, keep the number of segments as before or double the number, and nearly halve the width and connect two independent armature windings to alternate segments. Carbon brushes may now be thick enough to cover four segments, and set so close at the sides as to give required area, with but slight increase in thickness of segments. The cost of magnet windings may now be reduced, and the weight and length of magnets decreased, because the length of air gap can be reduced to that required to insure sparkless reversal of but half the current in each coil at moment of reversal. Bipolar machines must depend to a large extent on the adoption of above improvements for their continued use.

Seventh Annual Report of the General Electric Co.

The seventh annual report of the General Electric Company, which will be mailed to the stockholders this week, is an extremely interesting and important document. It comprises the separate reports of President C. A. Coffin; First Vice-President Gen. Eugene Griffin; Second Vice-President J. P. Ord, and Third Vice-President E. W. Rice, Jr., supplemented by balance sheet, table of securities held, etc. This is, moreover, the first report issued since the share capital of the company was scaled down 40 per cent., making the common stock $18,276,000 and the preferred $2,251,000. The patent account during the year was also scaled down from $8,000,000 to $4,000,000.

Mr. Coffin in his report presents the following net statement:

The profits for the year, after deducting all general patent and miscellaneous expenses, were	$3,896,884.10	
Deduct deficit as of Aug. 18, 1898, after reducing patent account and capital stock	1,840,761.03	
		$2,056,123.07
Less interest on debentures and current dividend on preferred stock		371,638.40
		$1,684,484.67
On Jan. 31 there had been paid or charged against surplus all accrued dividends on preferred stock		1,572,913.68
Surplus Jan. 31, 1899		$156,570.99

Gen. Griffin in his report states that the total sales billed to customers were $15,679,430, the cost being $13,094,534, leaving a profit on sales of $2,584,896. The increase in orders over 1897 was 21 per cent. Over 124,000 separate supply orders were received, and over 8,400,000 incandescent lamps were ordered. About 89 per cent. of the year's orders were on standard terms, of cash within 60 days. The year showed the largest volume of business for any fiscal year since its organization. The orders received during the past five years run as follows: 1895—$12,160,119; 1896—$13,235,016; 1897—$11,170,319; 1898—$14,382,342, and 1899—$17,431,327. Gen. Griffin gives a list of 24 plants of over ten miles transmission at from 5000 to 40,000 volts, and states that no fatal case of accident from such high pressure has been reported.

Mr. E. W. Rice, Jr., notes in his report the large increases made in the company's manufacturing facilities and in its engineering resources. The area of factory buildings now in use aggregates 1,800,000 square feet, or 41.3 acres enclosed, and the number of employees at work, at Schenectady, Lynn and Harrison, is given as 9000. Mr. Rice mentions the striking fact that the company has expended about $400,000 for machinery and tools in its new buildings, etc. About two-thirds of the power required for Schenectady is now regularly supplied from Mechanicsville, nineteen miles away.

The largest amount of space in the pamphlet is devoted to the exhaustive analytical report of Second Vice-President Ord, the comptroller, who occupies no less than eight pages with figures, data, etc. He states that the company had no notes payable out, and no paper under discount bearing the company's endorsement or guarantee. It had borrowed no money, and had not used its credit during the year either by issuing notes, or in endorsing customers' paper, or in lending its name in any way. During the year it had purchased and cancelled $300,000 of its own 5 per cent. gold coupon debentures. The company's factory plants are carried at a book value of $2,300,000 for Schenectady; $900,000 for Lynn, and $200,000 for Harrison. The land of all three plants is 160 acres. The other real estate includes the Edison Building in Broad Street. The more important stocks and bonds owned by the company are carefully scheduled, showing a par value of $13,745,542, and carried on the books at $6,984,775. In addition, the company owns securities of more or less speculative value, par valuation $288,560 carried at $116,053; sundry holdings, par $301,116 carried at $125,461, and 132 lots carried at $1 apiece. During the year the company sold stocks and bonds for $1,070,960 which had been carried at $746,498. The debts that are due the company appear at an estimated realizable value of $5,806,961 less an allowance of $720,412 for possible losses. The sales for the last three months of 1898 reached $4,151,904. There yet remains on the books the accounts of 131 debtors carried at $1 each. Last year this class of notes and accounts yielded $62,190 in settlements.

Mr. Ord explains that the work in progress item in the balance sheet represents only expenditures at cost on 315 incomplete plants, amounting to $507,335 after deducting partial payments received, and not including estimated profit. On the basis of calculation assumed the factories items exceed the book values. As to this and similar points, the following remarks are made by Patterson, Corwin & Patterson, the well-known accountants, who have made a critical examination of all the books: "The technical nature of the business of the company, and the wide range, number and variety of the articles manufactured, render it impracticable for any persons not mechanically expert in the various lines and familiar with the goods, to correctly identify and inventory them; therefore, the inventories at Jan. 31, 1899, were necessarily taken and priced by the company's own experts. We, however, noted the manner in which the inventories were compiled, item by item, and verified the computations. Our knowledge of the instructions given and the methods and precautions followed to insure correctness leads us to believe that said inventories were carefully and conservatively taken and that the total value of the goods is not overstated in the amount carried over in the balance sheet. We have not attempted to appraise the manufacturing plants, but in our opinion, which is based upon our observation of the methods of treating improvements to the plants and the amounts charged off for depreciation, the policy of the management regarding charges to plant is unusually conservative and commendable."

The Consolidated Balance Sheet of the Company of Jan. 31, 1899, is given by Mr. Ord as follows:

ASSETS.—Patents, franchises and good will, $4,000,000; factory plants, $3,400,000; real estate, $615,034.72; stocks and bonds, $7,226,422.45; cash, $1,456,793.53; notes and accounts receivable, $5,086,679.82; work in progress, $507,335.95; inventories, factories, general and local offices and consignments, $4,882,238.10; grand total, $27,174,506.57.

LIABILITIES.—Capital stock, 7 per cent. cum. pref., $2,551,200; common stock, $18,276,000; 5 per cent. gold debentures, $5,700,000; accrued interest on debentures, $74,500; accounts payable, $431,496.44; unclaimed dividends, $11,739.14; profit and loss, $156,570.99; grand total, 27,174,506.57.

The Consolidated Profit and Loss Account stands as follows:

DEBITS.—Balance Jan. 31, '98 (deficit), $11,725,561.03; red'n of book value of patents, franchises and good will, June 30, 1898, $4,000,000; total, $15,725,561.03. Balance brought down (deficit), $1,840,761.03. Cost of goods sold, $11,275,612.18; general expenses, taxes, sundry losses and allowances for losses, $1,818,922.07; total, $13,094,534.25. Patents and patent expenses, $269,440.41; interest on debentures, $290,000. Dividends on preferred stock—All accumulated dividends, viz: From July 1, 1893, to Dec. 31, 1896, paid, $1,041,740; from Dec. 31, 1896, tc Aug. 17, 1898, payable March 8, 1899, $486,173.68; current 7 per cent. dividend from Aug. 17, 1898, to Jan. 31, 1899, paid, $81,638.40; total, $1,609,552.08. Balance Jan. 31, 1899 (surplus), $156,570.99; total, $17,260,858.76.

CREDITS.—Reduction of capital stock Aug. 17, 1898: Preferred stock, reduced 40 per cent., $1,700,800; common stock, reduced 40 per cent, $12,184,000; $13,884,800; balance carried down, $1,840,761.03; total, $15,725,561.03. Sales, $15,679,430.86; royalties and sundry profits $792,590.82; $16,472,021.68. Dividends and interest received on stocks and bonds owned, $341,999.76; interest and discount, $119,953.61; $461,953.37. Profit on sales of stocks and bonds, $324,462.03; discount on debentures purchased and cancelled, $2,421.68; total, $17,260,858.76.

These are supplemented by a list of leading stocks held, showing a book value to par of $43.05, and of bonds showing a book value to par of $64.77.

CURRENT NEWS AND NOTES.

MR. A. P. TROTTER, formerly the editor of the London *Electrician,* who some years ago went to the Cape, is now to return to England, and will succeed Major Cardew as electrical adviser to the British Board of Trade. We are glad to hear of the return of Mr. Trotter to England.

OBJECTING TO ELECTRIC TRACTION.—The Cincinnati, Hamilton & Dayton Road objects to the use of electricity as a motive power along the banks of the canal between Dayton and Cincinnati. This objection took the form of a protest against the ratification of the contract entered into between the Board of Public Works and the projectors of the electric scheme.

WIRELESS TELEGRAPHY.—In view of the many telegraphic accounts given in the daily newspapers of the success of various experimenters in telegraphing by the Marconi system a few thousand feet or yards, it is interesting to note that Mr. A. V. Abbott, chief engineer of the Chicago Telephone Company, has for some months been telegraphing by this system between his office and residence, a distance of nearly two miles.

THE TESLA PATENTS.—The suit of the Tesla Electric Company vs. Gordon J. Scott and William S. Janney was argued April 24 in the United States Circuit Court of the Eastern District of Pennsylvania. The complainant in the suit is actually the Westinghouse Electric and Manufacturing Company. The cause at issue relates to the Scott & Janney alternating current motors, which are alleged to infringe Tesla patents on the rotary field, and on "split-phase" motors for single-phase circuits.

TRANSMITTING PICTURES BY TELEGRAPH.—The newspapers have again taken up the subject of Hummel's system of telegraphing pictures, and the New York *Herald* and the Chicago *Times-Herald* print illustrations purporting to be fac-similes of pictures transmitted between New York and Chicago. The system, as described, appears to be the well-known Caselli system of thirty years ago. Though the pictures printed are stated to be fac-similes of the pictures as received, they have evidently been redrawn in the newspaper offices, as the lines are those of a pen-and-ink drawing, and do not correspond to the lines that should be made by the receiver, if the description of the method given is correct.

THE CHICAGO ELECTRICAL ASSOCIATION.—Chief Engineer A. V. Abbott, of the Chicago Telephone Company, has been elected an honorary member of the Chicago Electrical Association, as a mark of appreciation of his work in wireless telegraphy. Mr. Edward B. Ellicott, city electrician of Chicago, and his assistant, Mr. W. Collins, were also elected honorary members, in view of their excellent work in connection with the city police and fire-alarm systems, and the electric lighting of Chicago. Prof. D. C. Jackson was at the same time elected an honorary member in recognition of his work in electro-chemistry and his experiments in connection with the electrolysis of water pipes. Mr. R. Fred. Schuchardt, of the Chicago Edison Company, has been elected secretary of the association, to succeed Mr. Cloyd Marshall, formerly electrical editor of the *Street Railway Review,* who has recently been appointed general manager of the Ross Acetylene Generator Company, of Lafayette, Ind.

ON THE FIGHTING LINE WITH PROF. CROCKER.—The latest news from Prof. F. B. Crocker, of Columbia University, who is now on a trip around the world, comes from India. In a letter to Prof. G. F. Sever, dated March 13, from the Bengal Club, Calcutta, he describes his good fortune in being able to witness some of the first fighting at Manila. His narrative is very interesting: "I was quarantined for eleven days on my way to Manila; but the result was that it kept me there until the fighting began on Feb. 4, so it was more fortunate than it seems while imprisoned on board a small steamer with hardly any passenger accommodations. The evening of the first attack the firing began at one point, but in less than five minutes had spread entirely around the city, the American lines being twelve or fifteen miles long. The shooting made an almost continuous rattle, with occasional reports of artillery. It was so near that the sound was very loud on all sides, but especially on the north; in fact several bullets struck the hotel on that side, one very near my window. This made me feel nervous, I confess, as it was my 'baptism of fire,' but there was so much to see outside that I soon got used to it and sat in the window. A battalion of infantry (Kansas) quartered near the hotel, started for the front at double quick, soon after the firing began. It was a most impressive sight to see them go by. No music or cheering, no sound from them except the tramp of their feet. Even the colors were held close to the staffs, so as not to impede the advance. The next morning ambulances with the wounded and bullock carts with the dead came back that same road. At midnight the firing slackened, but with the first appearance of dawn it recommenced and the 'Charleston' on the north with the 'Monadnock' on the south opened fire on the insurgent lines with their big guns (12 or 13-inch on the latter), the noise being awe-inspiring; and the shock produced by the guns themselves, as well as the explosion of the shells, actually shook the earth. That day I went out and saw the results of the battle at Paco and Santa Anna. By the way, I had been through the insurgents' lines at this point two days before, and they had been very overbearing. This time the village was burned to the ground, and I counted fifty dead Filipinos in one field. The insurgents were driven back a mile or two in every direction the first day, and the next day I saw the Nebraska Regiment and the Utah Battery capture the pumping station of the water-works, and this was about seven miles beyond the original American lines 48 hours before. The American troops fought magnificently. The volunteers are rather slouchy on the streets of Manila, but they are the finest soldiers in the world in actual battle. There wasn't the slightest sign of disorder when fighting began." After his arrival in India, he inspected a good deal of the electrical work, and speaking of Calcutta, says: "This afternoon I inspected a new electric-lighting station here (the first to be installed). The apparatus is all up-to-date, but the conditions are very peculiar. The station building and chimney were constructed by native workmen, the skilled bricklayers getting 15 or 20 cents per day, and the women, who carried up the bricks in baskets on their heads, received the munificent sum of 5 to 6 cents per day. This included the chimney, which was 150 feet high. In contrast to these primitive ways, we have the fact that the telegraph, telephone and electric light pole lines are the finest in the world, being put up according to Indian Government Standard specifications. One is continually being struck with such extraordinary differences as these while traveling."

THE MUNICIPAL OWNERSHIP FEVER has broken out in Terre Haute, Ind., and the Common Council has been induced to take steps looking to the purchase of the lighting plant. The question, however, will not stop with municipal lighting, other similar propositions being now agitated.

TELEGRAPH WAR IN KANSAS.—Several hundred damage suits were recently filed against the Western Union Telegraph Company in Topeka, Kansas, and similar suits are being instituted everywhere throughout the State. A recent law reduced telegraph rates and prescribed a penalty of $100 for each overcharge, and the suits arise from this measure.

RHUMKORFF COIL NOT INVENTED BY RHUMKORFF.—According to a French writer, Mr. de Fonvielle, what is known as the Rhumkorff coil was not really invented by the one whose name is bears, as he only perfected it, the real invention having been made by Prof. Masson, who was professor of physics in the College of Louis the Great in Paris. Unfortunately Mr. de Fonvielle does not describe what these perfections were. It seems to us, however, that the real invention was made by neither, but by Prof. Henry in Princeton much earlier. Henry not only invented the step-up transformer but the step-dow n transformer as well.

WIRELESS TELEGRAPHY IN INDIANA.—Prof. Greene, of Notre Dame, Ind., continued his experiments with the Marconi system of wireless telegraphy with gratifying results. In the first experiment the distance covered was 500 yards. In the second experiment the distance was increased to half a mile, and messages were transmitted perfectly. A higher wind prevented them during any previous trial, but no bad effect resulted. Prof. Greene tested the coherer at the receiving station and found its normal resistance to be 10,000 ohms. Under the influence of the waves from the sending station the resistance was reduced to ten ohms. Prof. Greene will attempt further experiments upon the arrival of a new relay, which is expected soon.

ELOQUENCE AND TECHNICS.—We quote the following from Smee's "Electro-Metallurgy" (1851), the sentence forming part of a description of a severe thunderstorm which visited London in 1842: "In that mighty operation of Nature which has just occurred, when the noise accompanying the discharge of electricity over the metropolis was so awful as to alarm not only delicate females, but the stoutest hearts of men, and even the heretofore unterrified nervous systems of infants—in that perfect storm when every living creature trembled and Nature seemed almost alarmed at her own operations, How vast was (I)! How large (A)!" Only after an extended search through the preceding pages was it found that (I) represented current and (A) electromotive force.

WAR TO BE MADE UNTHINKABLE.—Jan Szczepanik, the electrical wizard of Bohemia, who claims to have invented a method of photographing over wires, has lately supplied the newspaper press with another sensation—an electrical bomb that will "make war unthinkable." The apparatus, which consists merely of "a dry cell, a small spool and a kind of button-shaped relay," was originally made to discover the heart's electric power, but may be applied to blow up mines from a distance, and cause shells to explode immediately over the enemy. The latter is done "by casting the proper ray of light over the enemy, and the instant the shells reach that wall of ultra-violet rays, they explode with terrific effect." If our wizards do not bestir themselves they will be left far in the rear by the gifted Jan.

MARCONI TELEGRAPHY.—A cable despatch gives an account of a recent test made by Marconi on radiant telegraphy between a French warship and a lighthouse. The apparatus on the warship was connected with the wire elevated 150 feet into the air, and the tests are reported to have been entirely successful. In this connection we may note that in a paragraph in the concluding article in our columns by Signor Martinez on "Electricity in the Italian Navy," reference is made to some experiments by Prof. Pasqualini, in telegraphing from the shore to a torpedo boat 24 miles at sea. The despatch above referred to also states that successful experiments were made with a method of Marconi's for isolating messages. A number of tests were made, and in each case the message was received at the station for which it was intended, and not registered at neighboring stations.

ROBESPIERRE AND MARAT IN ELECTRICITY.—It is a somewhat singular fact that the names of two of the three leaders who were responsible for the Reign of Terror during the French Revolution, have some connection with electricity. Robespierre was probably th first lawyer engaged in electrical litigation, having been counsel in a suit to a man charged with sacrilege, on the grounds that he had put up a lightning rod to avert the fire of heaven. There is no record of the pleadings, but that they were effective is evident from the fact that the defendant was acquitted at a time when religious intolerance reigned supreme. Marat, besides being a physician, was an author of scientific books, one of his works being on electricity. A letter has recently come to light, in which Marat gives to a friend an account of medical cures effected by electricity. He mentions one case of a man whose sight has been gone for thirty-three years, and which was recovered through a course of electrical treatment. The letter speaks highly of electricity as a remedial agent when administered by a physician versed in its application.

WAR EXHIBITS AT MADISON SQUARE.—One of the features of the coming electrical exhibition at Madison Square will be loan exhibits from the War and Navy Departments. Among these will be an exhibit of the field telegraph and telephone, consisting of a telegraph cart, wagon, hand reels, outpost cart, etc. The heliograph will also be shown, as well as various instruments used by the Signal Corps for sending messages by wig-wag, telegraph, telephone and night-flash methods. A switchboard used at Ponce, Puerto Rico, will be on exhibition, which was constructed by Lieut. Col. Reber of sugar kettles taken from a plantation. The telegraph will be exhibited which was in constant operation in front of Santiago, and over which was sent the message of the surrender. Another interesting exhibit will be a map of the battle line at Santiago, giving a diagram of how the signal officers connected the different entrenchments by telephone with headquarters. The naval exhibits will consist of the Ardois signal system, a battle order indicator, helm angle indicator, a diving lamp, etc. There will also be shown a sample board illustrating the system of waterproof conduit wiring used on warships, and also samples of marine electrical material. Two extremely interesting exhibits will be the projector from the Spanish warship "Viscaya" and the searchlight of the battleship "Maine." The United States Lighthouse Board will have an exhibit illustrating the low-tension electric buoy system and the Henry alternating-current buoy system. Through the courtesy of Prof. Langley, there will be an exhibit from the Smithsonian Institute, showing numerous historic models of inventions illustrating the advance of electrical engineering.

SALE OF THE FORT WAYNE ELECTRIC CORPORATION'S PLANT.—On April 18 the plant of the Fort Wayne Electric Corporation, Fort Wayne, Ind., was sold at receivers' sale, and purchased by the General Electric Company. According to the receiver's inventory the total value of the corporation property, including real estate, merchandise, patents, equipment, furniture, securities, etc., was placed at $534,461.74. Mr. Chas. A. Coffin, president and general manager of the General Electric Company, submitted a bid in writing in behalf of his company, which bid was accepted, no other bids being presented. The sum paid by the General Electric Company was $356,400, which covers the entire plant and property of the Fort Wayne Corporation. Payment is to be made in the following manner: $185,000 is to be paid for with $185,000 at par value of the debenture bonds of the Fort Wayne Electric Corporation, which bonds are owned by the General Electric Company; the balance, $171,400, to be paid according to the terms of the decree of sale of the property. From the sum realized by the sale, in addition to the General Electric Company's $185,000, the following obligations must be met: Receiver's costs, $42,000; Charles A. Milding, trustee, $30,000; court costs, etc. (estimated), $20,000—total, $277,000, leaving a balance of $79,400. To this must be added collectable outstanding accounts aggregating, approximately, $66,000, and $8,000 in the possession of the receivers, making a total of $153,400 available for distribution among the unsecured creditors. The total unsecured debt of the corporation is $900,000. The works were reopened last Monday under the direction of Mr. J. J. Wood as superintendent, and Mr. F. S. Hunting as purchasing agent. It is thought that the General Electric Company will keep the plant in operation.

INCANDESCENT BULB AND SHADE REMOVER.—A patent was issued on April 18 to John J. Rhine, Pittsburg, Pa., for an appliance for inserting and removing incandescent lamp bulbs from sockets situated at such a height as to be out of the reach of a person of ordinary stature. The device consists of a combination of levers and a spring-actuated yoke, which grasp the lamp, the whole being mounted on the end of a rod with a spiral groove. By means of the latter the lamp is unscrewed from the socket, the mechanism resembling that of an automatic screw driver.

SINE-WAVE TELEGRAPHY.—Experiments were conducted in Washington on April 18, between the War Department and Fort Myer, Va., under the direction of Gen. Greely, chief of the Signal Service, with the so-called sine-wave system of telegraphy. This system, as is well known, is the invention of Lieut. George O. Squier, of the Signal Service, and Prof. A. C. Crehore. These gentlemen have conducted experiments over a submarine cable between New York and Canso, N. S., and reported to Gen. Greely that they had on this occasion attained a speed of 3000 words a minute. In the Washington experiment Kipling's poem, "The White Man's Burden," was transmitted to Fort Myer and back again, being repeated back and forth for an hour. It was found that in that time 120,000 words had been transmitted.

INDUCTIVE-DISCHARGE MECHANISM.—Three patents were issued on April 18 to Thomas B. Kinraide, of Boston, Mass., on various details relating to apparatus for producing inductive discharges. One patent relates to a discharge gap, consisting of two parallel disks, one of which is fixed and the other movable; the latter is provided with mechanism whereby the gap between the two disks may be accurately adjusted at any desired amount. Another patent refers to a circuit interrupter. A magnetic motor revolves a bar mounted on a central pivot; on each end of the bar is an anti-friction roller which strikes against the yielding arm of a break device, the arm projecting obliquely into the path of the revolving roller. Means are provided for varying considerably the time period of closed circuit. The third patent relates to a complete arrangement for obtaining inductive discharges, into which the above two devices are incorporated. This includes in addition, a combination of inductances and capacities whereby, it is claimed, a system is produced capable of automatically regulating itself so as to steadily maintain a given discharge and admitting of a wide range of frequencies.

THE VALUE OF THE TELEPHONE IN BUSINESS TRANSACTIONS.—A very forcible illustration of the importance to every progressive business man of availing himself of the modern methods and means of conducting business is presented in the following paragraph which is reproduced from the *Iron Age*: "The telegraph is too slow for modern business methods. At least that is the experience of a Western dealer in old rails. It happened on a recent holiday that two dealers in the same city went to their respective offices to look over their morning mail. Both received an offer of a lot of old rails from a railroad manager 200 miles distant. Mr. A immediately called up the railroad manager by long distance telephone, caught him in his office, and in a few minutes closed the transaction, involving about $50,000. Mr. B meanwhile called a telegraph messenger and sent a telegraphic offer for the rails. The telegram was delivered at the manager's office in due time, but as he had gone home it was held over until the following morning for his scrutiny. Mr. A, however, suffered no grass to grow under his feet, but on the same holiday called up a rolling mill 400 miles away, found the manager ready for business and sold the rails, thus cleaning up a profitable transaction within comparatively few hours, and long before the message sent by telegraph reached the person addressed. It is unnecessary to state the moral, as this is no fable."

AN ELECTRIC RAILWAY FOR PUERTO RICO.—The San Juan & Rio Piedras Railway Company has been incorporated at Albany, N. Y., by several New York gentlemen, to operate an electric railway and furnish electric light in Puerto Rico. The names of the incorporators are: P. H. McMillin, F. K. Curtis, J. J. Kennedy, R. B. Merchant, Warren H. Spurge and Robert Seager, all of New York City. The company will operate the first electric railway or electric light plant in the island. It has purchased the steam road running from San Juan to Rio Piedras by way of San Antonio, a distance of about eight miles. The road is still being operated by steam, but the new company will discard the steam power and substitute electric power, the overhead trolley system being used. The road will also be extended to run into San Juan; at present it runs only to the outskirts of the city. The work of reconstructing the road has already been commenced. The plant for furnishing power for both railway and lighting will be located near San Antonio. Arc and incandescent lights will be supplied to San Juan, Rio Piedras and the surrounding districts. In San Juan the company will have a competitor in the lighting business, for the Standard Electric Lighting Company is now occupying the field there. Mr. Kennedy, of the new company, states that it is the intention to build a park resort on the seacoast between San Juan and Rio Piedras. Mr. John A. Wilson, general manager of the company, is now in Puerto Rico.

EDISON'S WHITE MAGIC.—Mr. William Archer, the distinguished English dramatic critic, in some letters he is furnishing on this country to the Pall Mall *Gazette* says: "The application of electricity—light divorced from smoke and heat—to the beautifying of city life is as yet in its infancy. Even the Americans have scarcely got beyond the point of making lavish use of the raw material. But the raw material is beautiful in itself, and in this pellucid air (the point to which one always returns) it produces magical effects. The other night at a restaurant, I sat at the next table to Mr. Edison, and could not but look with interest and admiration at his furrowed, anxious, typically American and truly beautiful face. Here, if you like, was an example of nervous overstrain; but the soft and yet brilliant light of the restaurant was in itself a sufficient reminder that the overstrain had not been incurred for nothing. Electricity is the true 'white magic' of the future; and here, with his pallid face and silver hair, sat the master magician—one of the great light-givers of the world. A light-giver, I think, in more than a merely material sense. The moral influence of the electric lamp, its effect upon the hygiene of the soul, has not yet been duly estimated. But even in a merely material sense, what has not the Edison movement, as it may be called, done for this City of New York? Its influence is felt on every hand, in comfort, convenience, and beauty. The lavish use of electricity, both as an illuminant and as a motive power, combines with its climate, its situation, and its architecture to make New York one of the most fascinating cities in the world. Why good Americans, when they die, should go to Paris, is a theological enigma which more and more puzzles me."

SOUTH NORWALK'S MUNICIPAL ELECTRIC LIGHT PLANT.—Some interesting and instructive figures and facts are presented in the sixth annual report of the Board of Electrical Commissioners of South Norwalk, Conn. The report, which covers the fiscal year ended Oct. 12, 1898, shows a steady reduction in rates per lamp per night each year since the plant was first started. The rate for the first year was 20¾ cents, and during the term above mentioned it was 17 1-10 cents, including interest, depreciation and all running expenses. The latter figure, the report states, is lower than the average rates paid for street lighting with arc lamps throughout the United States, and for the past two years the rates were below the minimum paid by any city to any electric light company in this country for similar lighting service. The average number of lamps in service during the year was 100; the nightly runs ranged from 5¼ to 8½ hours; average number of nights lighted during the year, 309; average cost per kw-hour (interest and depreciation included) under, .07 4-10; average cost per lamp per night (interest and depreciation included), .17 1-10; average cost per lamp per year (interest and depreciation included) 309 nights, $53.03 6-10; average pounds of fuel per night (2 parts bituminous and 1 part anthracite dust), 2,159.51; average nominal candle-power per lamp, 1400; capacity of plant in 2000-cp lamps, 120. Commercial lighting was inaugurated on Oct. 31, 1898, with nearly enough business at the start to cover running expenses. The two-wire, 220-volt system is used. The Commissioners adopted the contract method of charging for electrical energy, developing an original plan upon which to fix and control rates. This was accomplished by reducing all forms of service to individual rates covering all costs, upon a sliding scale variable according to the different lengths of lighting periods of the different seasons. The contract system has worked very satisfactorily so far. Mr. A. E. Winchester, the electrical engineer, who is the commissioner in charge of the plant, is entitled to great credit for his work and its success.

MR. T. A. EDISON has recently had attributed to him the introduction of the telephone call, "Hello!" now so universally in use.

A PROPHETIC JUDGE.—In the case of Moses vs. Pittsburg, etc., Ry. Co., 21 Ill. 523, decided in the year 1859, Chief Justice Canton said: "Cars upon street railroads are now generally, if not universally, propelled by horses, but who can say how long it will be before it will be found safe and profitable to propel them with steam or some other power besides horses?" This sounds like prophecy of the first water.

KANSAS TELEGRAPH TOLLS.—The legislature at its recent session passed a law reducing the legal rate of telegraph tolls in Kansas 40 per cent. The companies have ignored the law and announce that they will fight it. It has been the custom for State officers to run bills with the Western Union and Postal companies and settle on the first of each month. State Auditor Coler has announced that he would decline to audit vouchers on May 1 unless the charges complied with the new law. The Attorney General advised this course, and now the telegraph companies must fight the state, a situation which they hoped to avoid.

DETROIT MUNICIPAL RAILWAYS.—Gov. Pingree and the other members of the Detroit Street Railway Commission have decided to hasten the test of the McLeod law, under which they are negotiating for the purchase of the street railways by the city, without waiting for the action of opposing attorneys, who, the governor alleges, are working for delay. The Commission has obtained the consent of the Attorney General to bring quo warranto proceedings in the State Supreme Court to determine all the questions raised by the attorneys of the Citizens' Committee of Sixty, who are opposing municipal ownership under the McLeod law. The latter will be invited to participate in the presentation of the case.

CABLE FOR THE PHILIPPINES.—Gen. A. W. Greely, Chief of the Signal Service of the army, has been in New York to superintend the stowing away of the 250 miles of cable to be carried to Manila bv the cable ship Hooker. The cable is intended to connect the important islands of the Philippine group. The Hooker was the steamship Panama, captured from the Spaniards during the late hostilities. She has been fitted up as a cable and repair ship. In fitting in the two large tanks designed to carry the cable her structure was weakened. The repairs made necessary have delayed her sailing until the last of the month, the original intention of the authorities being to have her sail during the early part of April.

BALL BEARINGS FOR CARS.—A number of experiments have been completed in Zurich, Switzerland, with ball bearings for street railways. They were all unsuccessful until M. Schuppiser arranged balls to take the side pressure as well as the weight. The arrangement consisted of two rows of sixteen balls each, 19-mm in diameter, for carrying weight, and two rows of twenty-six balls, each, 12-mm in diameter, for taking the side pressure. The bearings are arranged so that they may be moved into four new positions so as to distribute the wear. On one line the saving of power was found to be 20 per cent., and when the grade was small, 37.8 per cent. On another line an average of 24 per cent. saving was obtained. Previous experiments on this side of the Atlantic have not been very successful.

NEW MULTIPLE CONTROL ELECTRIC RAILWAY.—A patent was issued on April 18 to Wilhelm Stein, of Hamburg, Germany, for an electric railway system where a plurality of motor cars are provided for each train, the object of the invention being to enable motorman to operate the controllers upon all the motor cars. The invention consists of a controller on each car operated by a small motor, and means by which the motorman may regulate, start and stop the controlling motors. The latter are run synchronously and kept in operation continuously, intermediate or clutch mechanism being interposed between each motor and the controller for the car motor. The clutch mechanism produces the desired operation of the controller by means of electromagnets, whose circuits are controlled by a switch in charge of the motorman.

NEW ARC LAMP MECHANISM.—A patent was issued to Thomas E. Drohan, of Chicago, Ill., on April 18, for an improvement in arc lamps, having for its object the provision of means for more effectively securing the feeding and alignment of the upper carbon, and for preventing the carbon holder from descending below a predetermined point when the carbon is consumed to the shortest length allowed. The principal mechanism consists of a clutch comprising a slotted part and a roller within the slot, which latter normally engages the carbon. A clutch-releasing device engages the extended ends of the roller and permits the downward adjustment of the carbon within the carrier. When a pre-determined portion of the carbon has been consumed, the clutch-releasing device swings out of position in a manner to prevent the roller clutch from releasing the carbon.

THE CITY OF MEXICO'S STREET RAILWAYS.—In a communication to the State Department at Washington, United States Consul General Barlow, at Mexico City, gives some interesting facts concerning the operation of the street railway system in that city. The company owning the street railways in the city is about to substitute electric power for the animal traction heretofore employed. There are about 300 miles of track in the district, which includes the city. One short line of 1½ miles is called the "Baños" (or Baths) line. The rest belongs to the Compañia de Ferrocarriles del Distrito Federal. Until recently mules have constituted the traction power. For communication with suburban towns, the company has some large sixteen-wheel cars. Arriving at the outskirts of Mexico City these cars are coupled into trains of five or more cars, and are thence drawn at good speed by American dummy engines. Most of the cars of the company are constructed in the United States, though at the city workshops of the company they make all repairs and have built some cars. The steam suburban lines will probably be retained and used chiefly for freight. The street-car fares vary according to distance. In the city proper, they are 5 and 6 cents. Some of the suburban fares are as high as 30 cents. The electric power will be obtained from coal, but there will be no connection for the present with the electric light plants now in operation.

THE PHILADELPHIA EXPOSITION OF 1899.—Arrangements are going forward for the Exposition and Commercial Congress which will be held in Philadelphia this year, opening on Sept. 14 and closing Nov. 30. This exposition is intended to be one to further the development of American manufactures and the expansion of American export trade, and will be the first national exposition of that character ever held in this country. It will be held under the joint auspices of the Philadelphia Commercial Museum and the Franklin Institute, and it has been endorsed by the Congress of the United States, the Legislature of Pennsylvania and the councils of Philadelphia. The exposition grounds are situated on the west bank of the Schuylkill River, south of South Street bridge, and are 56 acres in extent. The four separate buildings will cover an area of eight acres. East of the central building and connected with it is the exposition power plant. It is adjacent to the Pennsylvania Railway tracks and affords excellent facilities for landing heavy exhibits. The engines, air compressors and dynamos are located in one end of the power house and the boilers in the other end. The second International Commercial Congress will convene during the exposition under the auspices of the Philadelphia Commercial Museum. It will be more numerously attended and of much wider scope than that of 1897. The important commercial nations of the world will be represented by specially appointed government delegates; influential business men will come as representatives of over 300 of the leading foreign Chambers of Commerce of Latin America, South Africa, Australia, India, China, Japan and other countries. In addition to the accredited delegates about 20,000 foreign business houses have been invited to send representatives to the exposition. There will be displayed samples of competing wares from Europe for the purpose of comparison and study by American manufacturers and to illustrate to foreign buyers the superiority of American goods. The Franklin Institute will celebrate its seventy-fifth anniversary in connection with the exposition and it is anticipated that there will be present a large representation of its widely distributed membership, embracing engineers, manufacturers and professional men from all countries. The exposition will be held solely in the interests of American manufacturers and producers and the exhibits will be particularly of manufactured goods and products of the United States. The great practical result of the exposition will be to bring together the American manufacturer and the foreign buyer, whom it is designed to interest in American machinery and products. Mr. W. P. Wilson, 233 South Fourth Street, Philadelphia, is the director general, to whom all communications should be addressed.

FAST TIME FOR A MESSENGER BOY.—With a gold medal on his breast an agent of the Chicago & Northwestern and Union Pacific Railroads, James Edward Elsey, district messenger boy No. 1118, of London, arrived in New York on April 22 from Hanford, Cal., where he had been to deliver a message from Henry McCalmont, M. P., to his sister, Mrs. Robertson. He sailed on the Cunarder Campania, and when he reaches the branch office in Piccadilly at which he is employed, to-day, Saturday, he will have made a journey of 14,000 miles in twenty-eight days—five hundred miles a day.

DELAWARE'S LIBERAL INCORPORATION LAW.—The Delaware legislature has just passed an extremely liberal and broad corporation law, by which every facility is afforded companies to transact their business. It promises to place Delaware in competition with New Jersey in the matter of incorporating large business enterprises. The preliminary incorporation tax in Delaware is 15 cents on every $1000, whereas in New Jersey it is 20 cents. The annual franchise tax in New Jersey upon a corporation of $25,000,000 capital is one-tenth of 1 per cent., namely $25,000 a year, while in Delaware the tax is one-twentieth of 1 per cent. on the first $3,000,000, one-fortieth of 1 per cent. on the next $2,000,000 and $30 on every million above $5,000,000, thus making the annual tax on a corporation with $25,000,000 capital $2600 annually, against $25,000 annually in New Jersey. The laws of Delaware allow all corporate meetings to be held out of the state, and the transfer books of the corporation can also be preserved anywhere outside of the state of Delaware at the will of the corporation.

A NEW STORAGE BATTERY.—A patent was issued on April 18 to Alexis Werner, of London, England, for a storage battery, the claims for which are that the positive electrodes are extremely light, the disaggregation of the positive material is completely avoided, the e. m. f. is increased in the proportion of about 25 per cent.; moreover, that the durability of the negative plate is greatly increased and the active material which it carries is more completely utilized. The electrolyte consists of a solution of sulphates of magnesium, cadmium and zinc. The positive is formed of a metallic support on which an alloy is electrolytically deposited from the solution. The negative plate consists of a lead grid support having on either side a cover of open-mesh fabric made of fine lead wire gauze, burned into conductive union with the grid. The spaces in the grid between the gauze are filled with active material, and further active material also placed on the exterior of the gauze, the whole being then consolidated by heavy pressure. It is stated that an electrolyte charged with salts, as in this case, has the effect of bringing about what may be called the "fatigue" of the negative plate, which necessitates the specially-constructed negative described. The active material for the positive plate is made of lead peroxide with the addition of minium, and a relatively considerable portion of a material such as sugar or gum arabic, mixed in a state of powder with the pasty material so that when it is afterwards dissolved out the active material is left in a porous condition.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material, etc., are from the port of New York for the week ending April 18: Antwerp—25 packages electrical material, $926. Argentine Republic—15 packages electrical material, $385; 14 cases electrical machinery, $1208. Africa—1 case electrical material, $5. British Australia—6 packages electrical material, $52. Berlin—10 packages electrical material, $1102. Brazil—109 packages electrical material, $3421. British West Indies—5 packages electrical material, $254. British Possessions in Africa—232 packages electrical material, $20,935. British Honduras—1 package electrical material, $37. British East Indies—19 cases electrical material, $422. China—7 cases electrical material, $105. Cuba—21 packages electrical material, $1240. Hamburg—90 cases electrical material, $7081. Hull—2 cases electrical material, $150. Leeds—2 cases electrical machinery, $35. Lyons—3 boxes electrical material, $100. Liverpool—20 packages electrical material, $941; 2 packages electrical machinery, $57. Mexico—210 packages electrical material, $2967. Manchester—9 packages electrical material, $430. Marseilles—3 cases electrical material, $203. Porto Rico—27 cases electrical material, $895. Stettin—4 cases electrical material, $2386. Santo Domingo—13 packages electrical material, $209. Trieste—5 cases electrical material, $192. U. S. Colombia—3 cases electrical machinery, $35. Venezuela—19 packages electrical material, $378.

LETTERS TO THE EDITOR.

The Nernst Lamp.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Under the title, "An Electrolytic Lamp" I notice in your valuable journal, page 311, a communication by Mr. Theodore Reymann relating to the preliminary warming of the Nernst lamp by means of arcs. I beg to state that the same idea had been previously put forth by the writer, and was described by him in the *Elektrotechnischen Anzeiger* of Dec. 16, 1897, and again in the same journal on Feb. 27, 1898.

F. GRUNWALD.

BERLIN, GERMANY.

A New Form of Interrupter.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—As the Wehnelt interrupter has excited considerable interest, it may not be out of place to state that similar results in interrupting a current can be obtained in an entirely different way by the following method: Procure an ordinary arc lamp of the direct-current type, and with a 50-ohm rheostat connected in series with the primary of an induction coil, place the whole across the mains of a 500-volt generator. Switch on the current and allow time enough for the carbon points to get white hot. Then take a straight-bar permanent magnet and place it near the burning arc—not so close as to blow it out, but just near enough to make the arc produce a "ripping" sound. This form of magnetic blow-out is thus a very high-frequency interrupter as long as the arc is maintained under the above conditions. I find that it is not necessary to use an arc lamp, as the same result may be had by simply holding two half-inch carbons stationary and about 1-32-m apart, starting the arc by touching the points with some conductor. A telephone receiver placed in the secondary circuit will produce the same tune as the arc.

ALBERT BARKER.

WATERTOWN, N. Y.

The Dimensioning of Armatures.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Referring to the letter of Mr. Kennedy in your issue of April 22, it is true that a circle is electrically a more economical figure than a rectangle for armature coils, but from a mechanical point of view it is a practical failure and is never used in modern practice. The old T-H arc dynamo which Mr. Kennedy mentions is a most unfortunate example to quote, for its circular drum wound coils have long since been abandoned for the Gramme ring form.

Dead wire is defined by engineers as that wire in an armature coil which cuts no lines of force. If I understand Mr. Kennedy's statement correctly, he considers that the end wire on a cylindrical armature cuts lines of force as well as the wire on the circumference. I can only say that I do not agree with him. The wire on the ends of the armature enables the coils to include lines of force, and it is by no means *useless* wire; in fact, to demonstrate this was the purpose of the article to which Mr. Kennedy refers, but it is certainly dead wire in view of the accepted definition thereof.

GEORGE T. HANCHETT.

NEW YORK.

Return Feeders for Electric Railway Systems.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I was much interested in the editorial comments in your issue of March 15, concerning return feeders for electric railway systems. You may possibly remember that at the meeting of the National Electric Light Association in Washington in 1894, I brought up this whole question in a paper entitled "The Importance of Complete Metallic Circuits for Electric Railways," and that quite a wide discussion resulted from the reading of my paper, it being subject to comment in most of the prominent daily and weekly papers throughout the United States. I am glad to note that the third section of your editorial fully endorses the position which I took at

that time in advocating insulated return feeders, so spaced as to give a uniform distribution over the line, and to afford a path of least resistance between the railway tracks and the station bus-bars.

I am gratified to know that in the opinion of the best experts, the position which I took at that time has been endorsed, although I do not think the matter has recently been placed to my credit. I had so much confidence in the insulated return feeder system, that I obtained a broad patent on the same, which patent I sold to the General Electric Company about one year ago.

Philadelphia, Pa. J. H. Vail.

The Handling of Electrical Supplies.

To the Editors of Electrical World and Electrical Engineer:

As your valuable paper has called the attention of the electrical trade to the articles of Mr. Gorman, Mr. Stacey and Mr. Roberts, and opens its columns for the discussion of the subject by your readers, I feel constrained to answer, in part at least, Mr. Meston's letter in the issue of April 15. First, in reference to financial responsibility, etc. If the mercantile agencies would gain their information from an authentic source, and the managers not send their clerks on the streets to competitors, who perhaps are not friendly to them, they could and would give a better and more substantial rating.

Again, there are those whose capital is ample for their present needs, who desire no credit, who perhaps think best not to give information to the mercantile agencies, who can pay cash for all they buy, and discount their bills, and yet have no rating. Then again, the writer knows that there are those whose ratings are good and who could not pay 25 per cent. on the dollar if they were forced to settle their indebtedness. The mercantile agencies are good things, but they would be much better if they were more careful from whom and where they get their information.

Mr. Meston is somewhat on the fence as to the handling of supplies by the retail hardware dealers. This is a question in which not only the manufacturers are interested, but also the jobber, contractor and supply dealer. I would suggest, and hope it will meet with approval, that the question be put in more of a categorical form, that it may be discussed pro and con. Let us discuss the question from a present standpoint purely, since it is never well to cross the bridge till you come to it, and let the future take care of itself. In the writer's opinion, in reference to retail hardware dealers handling electrical supplies, it will be so far in the distant future, if at all, that the majority of us will have passed from the scene of things electric, and those who follow will be in a much better position to grapple with the question, as the then existing circumstances will, no doubt, be entirely different from the present.

Let the question be put something like this: "Whether it is to the best interest of the electrical trade that the retail hardware dealers handle electrical supplies." Then the question can be debated from the side on which they are most interested.

Richmond, Va. W. D. Marrow.

The Value of Electric Brakes as Recuperating Devices For Automobiles.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—Permit me to briefly reply to Mr. Booth's paper on the above subject, published in your issue of April 8. During the past two years I have made a cause of the development of the regenerative controller for traction purposes. The results obtained in practice are very much of an improvement over Mr. Booth's figures. His statement that the use of regenerative controllers for electric automobiles has been abandoned in France, where they were largely used (because they stripped the gears), must be startling to a mechanic, and at the same time suggestive that there is a great deal of energy wasted which might be bottled up and used again to advantage.

While my figures have never been tabulated, as they would vary so much under every style of motor or different road, I am certainly convinced that in ordinary street railway practice we recoup to the line fully 30 per cent. of the amount of power absorbed in operating the cars, and as this returned energy is mainly absorbed by the cars near by, the losses in the line and track (which are usually very considerable), are avoided. One of my observations is that a 15-ton car descending a 6-per cent. grade, at a speed of 12 miles per hour, will generate sufficient current to run three cars on the level at about the same speed. To show how sensitive this method of control is, we might note that when running the car on the level, the differential ammeter and watt recorder will reverse directions, caused by changes in the line voltage.

The efficiency of reconversion by the regenerative method depends greatly on the operator. The stops may be so slow that the energy of momentum is entirely absorbed by the friction of the motor car, etc.; or they may be so quick that these inherent losses show trifling figures. In the former case the gain would be nil, while in the latter the efficiency with good apparatus might be as high as 60 or 70 per cent. Mr. Booth's figures seem to be faulty. For instance, he gives the power necessary to ascend a 10 per cent. grade as five times as great as that necessary as on the level. Rankine's formula, 5 1-3 (sin ϕ + .0045), shows that 10 per cent. grades require over 23 times as much power to ascend as level tracks.

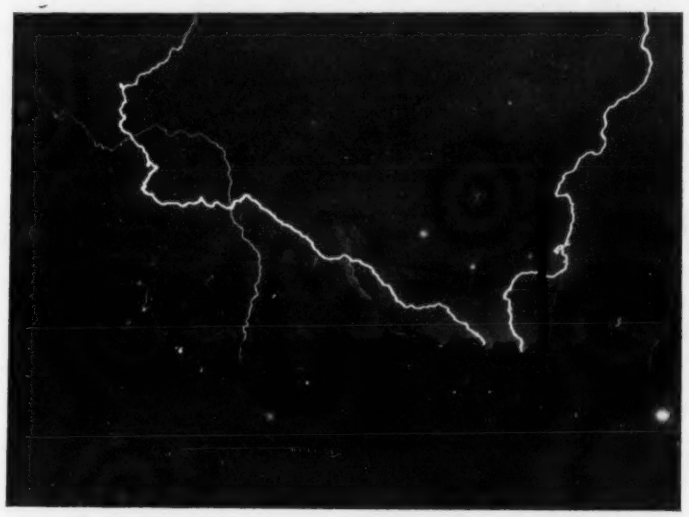
When you consider the increased range of speed regulation afforded by the regenerative system, the ease of starting, stopping or retarding on grades without the aid of such mechanical monstrosities as friction brakes, and add to them the economy over ordinary methods, it seems that the ordinary controllers now used on cars and on automobiles are destined to the "scrap heap."

Denver, Colo. John C. Henry.

Nature of the Lightning Discharge.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I have read with interest Dr. Morton's interesting note on the nature of lightning discharges, but must confess that I cannot see any evidence of spiral motion of the discharge. It is true that the photographs do present a twisted appearance, but it would appear that this may be largely subjective or due to other causes. For example it is stated that the photograph of the arc discharge and the lightning flash both represent opposing spirals meeting at a point, but to me the photograph of the arc discharge appears to spire from the right hand electrode in a clockwise manner, and from the other in a counter clockwise way, i. e., so that the whole discharge appears to be spiring in the same direction. Possibly Dr. Morton has overlooked the fact that two things which appear to twist in opposite directions when side by side are twisting in the same direction when placed end to end. Or possibly, as I said, the



A TRIPLE LIGHTNING DISCHARGE.

effect is subjective, and each may appear to him to be rotating clockwise, viewing them from the electrode from which they start.

Apart, however, from this debatable question I think that those who have done much work with high alternating current voltages will be more inclined to attribute the so-called "striations" to the fresh paths taken by the current every time the current is reversed. One discharge passes, and forms a streak of hot air, which rises. The next half period the current passes again, but as it can pass most easily through the hot and disassociated air, it does so. But as in the meantime this has risen, this next wave of current passes a little higher up, and gives a bright streak there. Thus we get as many bright streaks as there have been half periods. In the photograph shown there are, I think, 11 such streaks, so that this would correspond, at a periodicity of 133, to one twenty-fifth of a second exposure.

The photograph of the lightning flash (for we will assume it to be such, though such figures may be produced by other means) is not unlike some I have seen and may possibly be accounted for in the following manner: A lightning flash is sometimes stated to be of very short duration, in fact, inconceivably short. This is not true, as may be easily tested by watching a lightning flash, then turning the head away and looking at some other object and then back again at the flash. In most cases it will be seen to be still visible, and as the position of the retina has changed it cannot be due to optical persistence. I have measured flashes persisting slightly over one second.

Assume the flash to be taking place through air moving at the rate of 30 miles per hour. Then, since the flash follows the hot air, it is easily calculated that if the camera be of one foot focal-length and the flash be half a mile away, and the hot air moving at right angles to the camera, then the flash will appear as a bright streak of one-quarter inch width on the plate, owing to the fact that, as in the arc, the position of the discharge has moved. If the discharge be oscillatory, as it sometimes is, we will get on the plate a ribbon of greater or less intensity, with parallel bright longitudinal ribbing, one rib for each discharge. I have obtained such photographs, and enclose one with three discharges.

If, however, the discharge be persistent, or of great frequency, the ribbon will be evenly illuminated, with one exception. Where the ribbon curves up and down, there we will be looking through a greater thickness of luminous gas, and we will see those parts abnormally bright, thus giving a cross ribbing. I think that close inspection of the photograph, especially at the point *A*, will show that this may be the solution, the part to the left showing the ribbon almost horizontally, and that to the right the ribbon slightly tilted.

I enclose a photograph, showing the curious knots into which lightning sometimes twists itself (apparently), and also of interest as apparently showing that the telegraph wires (and to a certain extent the poles) were transparent to the light from the flash. This effect is due, no doubt, to the fact that the camera was focussed for infinite distance, so that the wires were out of focus. The two flashes took place one after the other and hit an iron street railway pole about 400 yards away, melting one guy wire and throwing the pole down.

ALLEGHENY, PA. REGINALD A. FESSENDEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Balancing Armatures.—Mr. Hill, in the Lond. *Elec. Rev.*, calls attention to the unreliability of the common method of balancing armatures by placing them on two horizontal rails, when the excess of weight will cause them to move in one or the other direction. He calculates that an excess of weight which would cause considerable vibration in a high-speed armature, would cause it to revolve in this test through only a small angle, as during the greater part of the revolution the weight is not sufficient to produce any movement of the armature; it is only when the excess of weight is nearly to the extreme right or left hand sides that it will be sufficient to show its presence. If unbalanced this weight will produce a centrifugal force of 663 pounds in a 1000 pound armature running at 750 revolutions, which is quite sufficient to cause considerable variation. To lay the armature on anti-friction wheels running on ball bearings is a much more sensitive way, but is still not sufficiently so. He therefore recommends using the centrifugal force itself, mounting the bearings so as to be free to move and finding the location of the excessive weight by means of a piece of chalk, as usual.—Hill. Lond. *Elec. Rev.*, April 7.

REFERENCES.

Rotary Converters.—A brief communication concerning the discussion of S. P. Thompson's paper. The utility of Thompson's method of determining the current distribution by superinterposition is not disputed, but it is claimed that the results are not accurate and that the truth lies between those obtained in this way and when the result of conceiving the moment of inertia negligibly small, is taken into consideration.—Sayers. Lond. *Elec.*, April 7.

The Induction Motor.—The continuation of a reprint of Wilson's paper. The present portion consists largely of tables of data and does not admit of being abstracted.—Wilson. Lond. *Elec.*, April 7.

The subject of the induction motor, in reference to this paper, is discussed editorially in that issue. The paper is devoted largely to the question of the starting of such motors and the tests refer only to the behavior of a certain 15-hp motor which the author tested very thoroughly, and unfortunately it was not a representative type. The editorial contains a brief summary of the qualities of induction motors.

Braking of Non-Synchronous Motors on Railways.—A long abstract with a number of the curves, of the article noticed in the Digest, Dec. 10.—Eichberg. *L'Eclairage Elec.*, April 1.

Armature Reaction.—A reprint of the complete paper, with illustrations, an abstract of which was noticed in the Digest, April 15.—Picou. *Bul. Soc. Int. des Elec.*, March.

Sparking Limit in Continuous Current Dynamos.—A translation of the paper abstracted in the Digest, Jan. 28.—Kapp. Lond. *Elec.*, April 7.

Magnetic Leakage in Transformers.—The conclusion of his long article (see Digest, March 11). No general conclusions are drawn.—Russell. Lond. *Elec.*, April 7.

LIGHTS AND LIGHTING.

The Hissing of the Electric Arc.—In the conclusion of the reprint of Mrs. Ayrton's paper in the Lond. *Elec.*, April 7 (see Digest, last week), she discusses the appearances of the crater, arc and carbons. As soon as hissing begins the whole appearance of the crater changes; a sort of cloud seems to draw in around part of it, moving from the outer edge inwards and varying continually in shape and position; the surface is divided into bright and dull spots. As soon as hissing occurs the arc seems suddenly to dart out between the carbons and to become flattened out as though under the influence of centrifugal force, acting at right angles to the common axis. Trotter showed some years ago that when the current in a lamp is greatly increased there was a sort of rotation of the arc at the rate of 50 to 450 revolutions per second; it is said that the arc is revolving at the rate of 450 revolutions per second at the moment it starts hissing. The only important modification of the negative carbon due to hissing, is the formation of the mushroom when the arc is short; the rapidity of its growth is so great while hissing that it is often necessary to separate the carbons instead of bringing them together in order to keep the length of the arc constant. The most important of all the changes is the alteration in the shape of the positive carbon. Luggin, in 1889, was the first to show that there was a direct connection between hissing and the relation between the area of the crater and the cross-section of the tip of the positive carbon; while her early observations led to similar conclusions, she found that with hissing arcs the crater always appeared to more than cover the end of the positive carbon, overflowing at is were, over its sides. A number of illustrations are given showing the shape of the carbons under various conditions with silent and hissing arcs. It is possible to tell with the normal arc, from a mere drawing of the positive carbon and its crater, whether the arc with which it was formed had been open or enclosed, short or long, silent or hissing, burning with a large or small current for the size of the carbon. With a small current the tip of the positive carbon is round, the crater lying in its smallest cross-section, while with a large current the tip is practically cylindrical for some distance and the crater has burned away a part of it, making it appear as though it had been sheared off obliquely; with a hissing arc the area of the crater is practically greater than the smallest cross-section of the type. The real and crucial distinction between the silent and the hissing arc is that the arc is silent when the crater occupies the end of the positive carbon only; but when it not only covers the end but extends up the side, the arc hisses; hence the arc must be at the hissing point when the smallest increase in the area of the crater will make it begin to cover the side of the positive carbon. The extension of the crater up the side of

the carbon is not the effect but the cause of the hissing, hissing being produced by the crater becoming too large to occupy only the end of the positive carbon. She shows how the law for the largest silent current may be deduced on this hypothesis. Keeping the length of the arc constant and gradually increasing the current, must lead to a hissing point. The longer the arc the greater must be the area of the crater, and consequently the greater the current before hissing. A positive carbon with a long fine point would require but a very small current to make it hiss; if the end were filed flat a considerable current would be required for hissing. She then discusses the question why the arc should hiss when the crater runs up the side. She believes that it is due to a part of the surface burning instead of volatilizing, and gives some reasons. She experimented with a number of arcs of different lengths in enclosed vessels and found no sudden diminution of the voltage with increasing currents, while such a diminution would have occurred if burned in the open air. Experiments were also made with air-tight, fireproof crucibles having mica windows; they all showed that when free from air, no sudden fall in voltage was observed on increasing the current far beyond the hissing value. With the aid of tubular carbons an experiment was tried by blowing air through the carbon and with the normal arc, hissing was produced every time a puff of air passed into the arc. Moreover, all the effect was produced by the oxygen in the air and not by nitrogen. The hissing is not due to the cooling effect of the air, but to the oxygen. Hydrogen blown into the arc in the same way, seemed to produce hissing like oxygen, but the fall of voltage was only about 6.5; moreover, hydrogen had a totally different effect on the enclosed than on the open arc, as it produced no hissing in the former. When the negative carbon was hollow and the gas is blown through it, no hissing or fall of voltage was produced in any case provided the stream was not great. There can be no doubt but that the sudden fall of voltage accompanying hissing of the open arc is due to the oxygen getting at the crater.—Mrs. Ayrton. Lond. *Elec.*, April 7.

The paper is praised and briefly discussed editorially in Lond. *Elec. Rev.*, April 7, and the reprint is also continued in that journal.

Nernst Lamp.—The Lond. *Elec.*, April 7, contains a long communication by Mr. Johnston (of Schenectady), in which he expresses disagreement with some of Mr. Swinburne's recent statements concerning this lamp. He believes that the latter has been too sanguine and that the lamp, although a beautiful possibility, is not yet a realized commercial factor, and perhaps never will be. He calls attention to an earlier announcement of the principle of this lamp in 1885 by Van Gestel and Beck, who worked in a similar direction; they used kaolin, the arc being employed as a heating agent; American patents were issued July 14 of that year. He refers to some extended tests of the Nernst lamp covering many weeks, after which it was finally abandoned as absolutely impracticable for ordinary commercial purposes. Swinburne claims that the "limiting resistance" required is 10 to 12 per cent. of that of the entire lamp, which Johnston supposes means 10 to 12 per cent. of the hot resistance; it was found necessary, however to use a limiting resistance many times this. It was also found impossible to get any efficiency or life with the continuous current, as the candle power ran down very rapidly. The real candle power, moreover, is very deceptive even to the experienced.—Johnston. Lond. *Elec.*, April 7.

REFERENCES.

Incandescent Bodies for Lamps.—The beginning of a long extract of an article apparently of a historical character, showing the development of electric incandescent lighting; it was prepared partly to show the early developments of the Nernst and the Welsbach inventions.—Schuler. *Zeit. f. Beleucht.*, March 30.

POWER.

REFERENCES.

Transmission by Alternating Currents.—The fifth part of his very long theoretical paper, (see Digest, March 25). In this portion he discusses redressing transformers.—Leblanc. *Bul. Soc. Int. des Elec.*, March.

The third part of his other long mathematical series (see Digest, April 1), is continued in *L'Eclairage Elec.*, April 1.

Elevators and Cranes.—Brief illustrated descriptions of various mechanical applications of electricity to elevators and cranes, taken from patent specifications.—Richard. *L'Eclairage Elec.*, April 8.

Equivalent of a Horse-Power.—Reprints of some tables from the Lond. *Engineer*, giving the equivalents of a horse-power in terms of units of work, quantities of coal, pressure, gas, heat units, etc., per hour, per minute and per second.—Lond. *Elec. Rev.*, April 7.

TRACTION.

Mechanical Traction in Paris.—L'Eclairage Elec., April 1, gives a brief abstract of an article summarizing the various methods of mechanical traction in use in Paris at the end of the last year. Thirty-one railway lines were then using mechanical traction (meaning by a line, the car circuit or route, as quite a number of lines are operated by each company). Of these, six were operated by accumulators, two by a combination of accumulators and overhead lines, two by overhead lines, one by an overhead conductor and a conduit, one by surface contacts, and one by a rack and pinion; the rest use compressed air, steam, etc. There were altogether twelve systems used on these thirty-one lines. Another line is in process of construction in which the overhead line will be used outside of Paris and the electrical conduit in the city. Brief data is given for the electrical lines.—*L'Eclairage Elec.*, April 1.

Automobiles.—The third instalment of Lavergne's long article is published in *Rev. Gen. des Sciences*, March 30. It describes with the aid of a few illustrations many forms of vehicles, mostly, however, non-electrical, the present portion referring to the vehicle itself (see Digest, last week.) In his conclusions he compares the advantages of the different kinds of power, mentioning the well understood advantages of both. Electrical accumulators, he says, are heavy, expensive to maintain and require frequent and long recharging. Steam, he concludes, will be used in general, petroleum for touring and electricity for city service.—Lavergne. *Rev. Gen. des Sciences*, March 30.

REFERENCES.

Ostend Accumulator Traction.—Some of the data in the paper noticed in the Digest, March 25.—Lond. *Elec.*, April 7.

Motor Carriage.—A brief description with an external view of the Joel electric carriage.—Lond. *Elec. Rev.*, April 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Measuring the Voltage at Distant Ends of Feeders.—To obtain the mean voltage at the distant ends of various sets of feeders by means of return potential wires, the method often used is to connect all the potential wires of the same polarity together at the station and thence to the common voltmeter, the potential wires being first all brought to the same resistance. Fritsche, who first proposed this method, claims that the error involved can be neglected. In an article by Dr. Teichmueller in the *Elek. Zeit.*, April 6, he shows analytically how great the error is and how it may be avoided. In a certain case taken as an example the error was as much as 1.1 per cent., or about 1.2 volt, which is too great to be neglected. It is very important, moreover, not to use the same voltmeter for measuring the voltage at any single pair or at the station, without proper external resistances, as errors of over 5 per cent. can thus be made. He calculates the true values analytically and then shows that by a very simple means, correct results may be obtained in all cases. This consists simply in using an adjustable resistance in series with the instrument; the resistance must have particular values depending upon the number of potential wires in circuit. The best way is to calibrate the instrument originally with about 100 ohms in series with it and then arrange the resistance so that the total external resistance will always be 100 ohms; a resistance of that value is placed on the switchboard and divided off into the necessary steps so that its value combined with the resistance of the potential wires, always equals the same amount. All the potential wires should have their individual resistances balanced so as to make each one equal to the other. A convenient form of voltmeter switch for switching in these resistances is shown. For four sets of potential wires there are three resistances, one to be used with only one set of wires, a second resistance is added when two pair are used in multiple, and another with three and none at all with four. This instrument has been adapted by Siemens & Halske Co.—Dr. Teichmueller. *Elek. Zeit.*, April 6.

Transformer Cut-Out.—An illustrated description translated from *La Nature* is published in the *Sc. Am. Sup.*, April 22, of an apparatus the object of which is to cut a transformer in and out of circuit by closing or opening the primary from the point of consumption, so as to save the magnetizing current when there is no load on the secondary; it is a French apparatus and is intended more for the use of elevators and motors. The principle is that an electromagnet opens and closes a switch in the primary circuit. The current for the electromagnet is a battery current and its circuit is operated from the elevator or motor just before or after the current is used.—*Sc. Am. Sup.*, April 22.

Temporary Connection to a High Voltage Circuit.—An illustrated description is given in the *Elek. Zeit.*, April 6, by Mr. Kowaleff, of a convenient form of instrument for making a temporary branch connection to a live high voltage circuit It consists of a long insulated rod the end of which contains a metallic hook and a knife edge which may be forced against it by means of a screw which is turned with the aid of the insulated handle This hook may thus be securely clamped onto a live wire and a connection thus established between a branch wire which is first attached to the hook By means of a bayonet clamp the hook is then released from the handle and left attached to the wire.—Kowaleff. *Elek. Zeit.*, April 6.

REFERENCES.

Cologne.—Long tabulated extracts from the operating statistics of this large station.—*Elek. Zeit.*, April 6.

Municipal Electric Light Plants.—Some tabular extracts from some recent reports to the House of Commons on reproductive undertakings carried on by municipal boroughs.—Lond. *Elec. Rev.*, April 7.

WIRES, WIRING AND CONDUITS.

Wire Gauge.—A brief illustrated description of the Stupakoff wire gauge and comparometer is given in *Eng. News*, April 13. It is a round, flat gauge, the edge of which is a spiral, and there is a radial arm which can be moved around and will measure the diameter of wires between its end and the outside edge of the disc. The advantages are that quite a large number of scales can be engraved on its face, which are read from the edge of the radial arm. Besides the different gauge numbers it contains the diameters in millimeters, inches, etc. The design also admits of engraving on it of various data which would be of use to electricians in connection with the various carrying capacities of different sizes of wire. It also enables a vernier to be used. The instrument is not yet on the market.—*Eng. News*, April 13.

Paper Cables in Telephony.—The Lond. *Elec. Rev.*, April 7, contains a short article of a general nature on paper cables. The minimum capacity per mile of an ordinary india rubber cable is given as 0.29 microfarad, while that of a paper cable should not exceed 0.085 and is frequently lower; 0.080 should be the capacity for all the wires in a cable when all but the one under test are earthed; the conductor has a resistance of 42.3 ohms per mile, the diameter being 36 mills. It is briefly described how the wire is covered and how the cable is made and joined. An illustration is given of a terminal box; another of a device for drying the air to be pumped into these cables for drying out leaks; this consists of a series of U-shaped tubes containing calcium chloride; the air is forced through the drying apparatus and cables at a pressure of 15 pounds per sq.in; the hissing sound made by the escaping air aids in the localization of the fault.—Lond. *Elec. Rev.*, April 7.

REFERENCES.

House Connection for Alternating Current Circuits.—A detailed illustrated description of how to make a house connection with a high tension underground circuit.—Helm. *Elek. Zeit.*, April 6.

ELECTRO-PHYSICS AND MAGNETISM.

Oscillatory Discharge of a Condenser.—A Physical Society paper by Messrs. Barton and Morton, abstracted briefly in the Lond. *Elec.* and *Elec. Rev.*, April 7, discusses how the condition for the oscillatory discharge of a condenser is modified when the ordinary differential equation of the second degree is supplemented by the terms of Maxwell to take account of the distribution of the current in the wire. It is shown that a condenser satisfying the critical condition in the simple formula would, when the added terms are taken into account, give an oscillatory discharge. In the discussion Everett thought the authors had proved that the effect of "throttling" was to indicate the tendency toward the oscillatory mode of discharge. Lodge thought their conclusions were singular and unexpected.—Barton and Morton. Lond. *Elec.*, April 7.

REFERENCES.

Induction Coil Spark Analyzed.—An abstract, with some illustrations, of the article noticed in the Digest, March 25.—Walter. Lond. *Elec. Rev.*, April 7.

Dielectric Polarization and Hysteresis.—A longer abstract of the article noticed in the Digest last week.—Schaufelberger. *L'Eclairage Elec.*, April 8.

Electrification by Vapors.—An article on the electrification of vapor from electrified and non-electrified liquids; the application to atmospheric electricity; and on the effect of smoke.—Pellat. *L'Eclairage Elec.*, April 1.

Photo-Electricity.—Brief descriptions of some investigations in which he used the oxide of copper, in studying the nature of photo-electric currents.—Schmidt. *Wied. Ann.* No. 3; abstracted briefly in Lond. *Elec.*, April 7.

Lorenz Theory and Zeeman Phenomenon.—A long theoretical discussion.—Poincare. *L'Eclairage Elec.*, April 8.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon Electrodes.—Dr. Zellner has made very extended researches with carbon electrodes used for electrolysis and published the results in the *Zeit. f. Elektrochemie*, April 6. The article seems to contain much of value; one of the principal features studied was the destructive effects on various carbons, that is, their ability to withstand destruction. The specific gravity of carbon is no measure of its value for electrolytic purposes; the Girard and Street carbon, for instance, which is treated by the electric arc and has a specific gravity of almost 2 gr. per cb-cm, suffers greater loss than other carbons of lower density; this is true even to a greater extent of those made of Ceylon graphite; a much better indication of the quality is a determination of the porosity which is determined by taking the true specific gravity in the pulverized condition, being careful to boil it in water, and then determine the apparent gravity of another sample from the weight and volume; from these two measurements a factor called the porosity may be determined. He gives the values of these two quantities for 15 different carbons, all apparently made on the continent. The true specific gravity of retort carbon is 1.89, which seems to be a little higher than the average of the others; the lowest porosity was 4.5 for a glass hard carbon and the greatest 22 for a certain arc light carbon; for retort carbon it was 8.5. This porosity factor is obtained by dividing 100 less the difference of the two, by the true gravity determined from the pulverized material. Carbons with low porosity are better for electrolytic purposes, as there is less room in their interior for the development of gases. He does not favor the carbons made of wood charcoal. The raw carbons with the exception of graphite and retort carbon have a very high specific resistance, more than 2000 ohms; the variations between different samples of the same carbon are very great. The consumption of the carbon is not uniform and depends on the relation of its resistance to that of the bath. The specific resistance in ohms for a number of different kinds is given; that of natural Ceylon graphite is 2 to 8, of retort carbons 50 to 80, and of electrodes from charcoal 150; the others vary greatly, but are similar to retort carbon. Those carbons will last longer in which the wear is uniform, which was shown by experiment. The consumption is nearly proportional to the time and to the current density, but is very different in different electrolytes; the consumption during different times is given. In alkaline or neutral solutions there is less loss than in acids; a table gives the behavior of different kinds and in different electrolytes. Sulphuric acid at 30.4 per cent. of the monohydrate, has a maximum conductivity, as he shows; there is then a minimum consumption of carbon. The sawed retort carbon is exceeded for electrolytic purposes by several of the artificial forms. The value of the carbon does not depend on its specific gravity but on its structure; low porosity is in general favorable, but is not an indication of its capability to withstand consumption. The consumption of carbon depends within limits on the voltage and current strength and is independent of the form and active surface, or, in other words, current density and consumption of carbon are proportional. Carbon plates will last longer the higher the conductivity of the electrolytes, and therefore the lower the voltage and temperature. The proper relation between the resistance of copper and that of the bath, increases the life.—Zellner. *Zeit. f. Elektrochemie*, April 6.

Chemical Energy in Cells.—Dr. Tommasi, in the Lond. *Elec. Rev.*, April 7, discusses the relation between the heat given off inside of voltaic cables and the heat capable of being transmitted to the circuit in the form of chemical energy. It is well known that the e. m. f. is proportional to the heat given off by the chemical action and can be calculated from it; but this heat may or may not be transmissible to the circuit, according to the nature of the chemicals. Thus, for instance, in the sulphating of zinc in a simple zinc-platinum-sulphuric acid couple 38.8 calories are evolved, but of this number only 29.8 can be transmitted to the circuit; the remaining 9 being retained in the battery. Moreover, two batteries of a certain kind will not decompose water when it is acidulated with sulphuric acid, but will do so if acidulated with hydrochloric acid. He shows that it is the compound which absorbs the least heat which tends to be decomposed in preference by the voltaic current, but on the condition,

however, that the reaction can be begun. He also shows that the e. m. f. of the same couple varies according to the nature of the positive electrode. He points out a certain peculiar behavior of magnesium.—Tommasi. Lond. *Elec. Rev.*, April 7.

Units, Measurements and Instruments.

Wehnelt Interrupter.—In the Lond. *Elec.*, April 7., Mr. Marchant claims that the multipolar interrupter has been found very useful; in this there are a number of platinum anodes with one common lead cathode. A great objection in the use of the Wehnelt interrupter is the rapidity with which it fatigues; this was found to be due almost entirely to heating for when the solution becomes hot the instrument refuses to operate. With suitable resistances in series it was found possible to stop the intermittent discharge by increasing the number of anodes, that is by increasing the capacity and slightly diminishing the resistance, exactly as with the Leyden jar discharge; this confirms the theory of resonance; when no resistance is in series this cannot be done, as the resistance diminishes approximately in the same ratio as the capacity increases.—Marchant. Lond. *Elec.*, April 7.

Mr. Brooks in the same journal calls attention to the use of the instrument for converting an alternating current into a uni-directional one, by which he seems to mean that an induction coil operated with it will give the same kind of a discharge with that an alternating current in the primary as it does with a continuous current and contact breaker. A vacuum tube of suitable length and oxygen is invaluable as a guide to the nature of the discharge. The interrupter works excellently with an X-ray tube.—Brookes. Lond. *Elec.*, April 7.

In a French Academy paper by Mr. Pellat, abstracted in *L'Eclairage Elec.*, April 1, he points out a curious fact which he noticed in using this interrupter. He placed a Carpentier ampere meter (presumably one of the ordinary form containing a permanent magnet, a fixed coil and a movable needle) in series with the interrupter and coil, and he then found that the mean intensity of the current was greater and at times considerably greater when the circuit contained the primary of the coil, than when it was closed with the primary switched out. With 70 volts from accumulators and the primary inserted, the instrument registered 20 amperes; after short circuiting the coil with a wire, the current diminished to 15 amperes. With a 110-volt lighting circuit and the primary cut out, the reading was 4 to 5 amperes while with the primary in circuit it was 25 amperes. This shows that by introducing an impedance into the circuit the mean intensity of the current is greatly increased. This fact, although at first sight paradoxical, is not in contradiction with the laws of induction, which he then proceeds to show analytically.—Pellat. *L'Eclairage Elec.*, April 1; abstracted in the Lond. *Elec.*, April 7.

Interrupter for Induction Coils.—Dr. Villard, in the *Rev. Gen. des Sciences,* March 30, describes with the aid of illustrations, a form of interrupter which has the advantage that it can be used with alternating or direct currents. The one for alternating currents consists essentially of a tuning fork having an extension on one prong, the extension passing between the poles of a permanent magnet; the current flows through the fork and this extension, and thence through a contact bar into mercury; this fork is tuned by means of sliding weights to the same frequency as the alternating current and it will therefore operate synchronously with that current; the current passing between the primary will then always be in the same direction and the interruption will be at the moment when its intensity is a maximum. The apparatus works equally well with high tension continuous currents, meaning those from incandescent circuits. For low voltages the interruptions will be too rapid and he therefore prefers a similar apparatus which is shown, in which the tuning fork is replaced by a strip of copper stretched so that it can vibrate, a conductor being screwed to the middle of it and passing between the poles of the magnet as in the other case.—Villard. *Rev. Gen. des Sciences,* March 30.

Recording Instruments for Testing Insulation.—If a voltmeter be connected between any wire of an insulated net work and the earth, whether in a two or three-wire system, and then shunted by a known resistance, the insulation resistance of the net work may be calculated from these readings. A recording voltmeter on this principle was recently devised by Travailleur and is described briefly in the Lond. *Elec.*, April 7, in which the voltmeter is automatically shunted for a short period once an hour. The instrument is connected between one of the switchboard bus bars and the earth and thus gives a continuous indication of the insulation resistance. It contains a permanent magnet and the device for switching in the shunt is a wheel driven by the clockwork which moves the paper chart. It is thought editorially that the instrument will not be used in general as in most installations the middle wire is earthed at the station. Another instrument is briefly described for such cases which records the current flowing from the middle wire to earth.—Lond. *Elec.*, April 7.

New Form of Resistance Box.—An illustrated description of a somewhat novel departure is described in the Lond. *Elec.*, April 7; the object is to overcome the objections due to the plug resistances. The coils are arranged in five rows of thousands, hundreds, etc., and proportional coils, and contacts are made by means of shoes which slide horizontally over studs in a straight line, being operated by rods which pull out through the side of the box; the readings are taken conveniently, as numbers are exposed on the rods as they are pulled out.—Lond. *Elec.*, April 7.

Use of Magnetic Instruments for Discovering Iron Ore Deposits. The Iron Age, April 13, contains a long illustrated abstract of a a recent paper by Professor Nordenstroem, of Stockholm, in which are illustrated and briefly described various forms of modern instruments used in Sweden for locating deposits of iron ore chiefly of the magnetic kind. Such instruments have nowhere been used so long and extensively as in Sweden, nor have they reached such perfection in any other country; he suggests that they might be used to almost equal advantage in other countries as well. In Sweden they have been used for nearly 200 years, but the preesnt ones are of an improved kind. Chief among these are Thalen's magnetometer and Tiberg's inclinator, both of which are described and illustrated, although the descriptions are somewhat meagre. The former seems to consist of a compass on a tripod, and a radial arm having a movable magnet on it. In making a survey the instrument is set up at the corners of squares into which the field is divided, each square having about 30 ft. to the side, and the angle of deviation is noted for each corner of every square; these are then plotted and points of equal value are joined with a curve, and from the shape of these curves the location of the ore deposit is then seen. The Tiberg instrument is somewhat similar but is placed first in a horizontal and then a vertical plane, measuring both deviations which also are plotted. The application to underground surveys is also briefly described. In conclusion he expresses surprise that these instruments have not been used in practice in other countries and he believes it due to a lack of knowledge of their practical value.—Nordenstroem.—*Iron Age,* April 13.

References.

Variations of the Clark Cell.—A reprint of the Physical Society paper describing a series of experiments comparing the e. m. f. of certain standard cells at frequent intervals for nearly a year. The paper is thought to contain but little of value.—Trotter. Lond. *Elec.*, and *Elec. Rev.*, April 7.

Measuring Instruments.—Brief illustrated descriptions of various forms of meters taken from patent specifications.—Armagnat. *L'Eclairage Elec.*, April 1.

Meter.—A brief illustrated description of the Cauro meter, which is of the usual motor type with a copper damper; it has a compensating field.—*L'Eclairage Elec.*, April 8.

Electrochemical Equivalent of Silver.—A longer abstract of the article, a brief one of which was noticed in the Digest, March 11.—Kahle. *L'Eclairage Elec.*, April 8.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—A communication from Prof. Fleming to the London *Times* is reprinted in the Lond. *Elec.*, April 7; it concerns chiefly the present experimental work of Marconi whose system is now being used between South Foreland and Boulogne, that is across the English Channel, and between a lightship on the Goodwins and the South Foreland lighthouse. Across the channel messages are sent at the rate of 12 and 18 words per minute printed in telegraphic signals on the ordinary paper slip. The height of the vertical wires is 150 feet and the distance between the stations 30 miles. He believes there should be a more generous appreciation of the fact that Marconi has made such a success of the system, due largely to minute attention to details and the use of the long vertical wire; the apparatus is ridiculously simple and not costly, the appliances at both stations with the exception of the vertical wires, costing not more than $500, for telegraphing across the channel, or even 100 miles. Up to the present time none of the other systems using electric or magnetic agencies, have been able to accomplish the same result over equal distances. He admits that wireless telegraphy will

not take the place of telegraphy with wires, each having a special field of its own.—Fleming. Lond. *Elec.*, April 7.

Fuses for Telephone Lines.—A brief illustrated description of a system proposed by Mattausch is given in the *Zeit. fuer Elek.*, April 2. He argues that the only proper place for inserting fuses to protect the line from crossings with those for high voltage currents, is to insert the protective fuses in the line at two points immediately beyond where the telephone line crosses the other, so that in the case of a cross, only a short portion of the line is cut out; if this is not done and if the fuses are placed only at the station end, fire may be caused by the current traveling a long distance along the telephone line on the way to the station. His method is to insert in the line, an insulating block capable of standing a tension, like those of the overhead trolley circuits, thus breaking the electric continuity of the line and suspending below this and attached to both ends, a fuse. Several forms of these fuses are shown. He does not seem to consider the inconvenience due to the locating of these fuses, in case they have been blown, but perhaps this is no great objection, as the location of the cross would have to be looked up in any case.—Mattausch. *Zeit. fuer Elek.*, April 2.

Telephone Service.—A long abstract from a recent parliamentary paper on the telephone service in countries foreign to England, is published in the Lond. *Elec.*, March 24. The information was obtained by consuls in the form of answers to various questions. From the United States only one report was received, it refers to New York, and is very brief. In the continental countries, the one in which the service resembles at all that in New York, is in the cities of Rome and Florence, both of which are served by private companies. Helsingsfors, in Russia, is the only other one in which the service is in the exclusive control of a private company. Municipal plants exist in the Netherlands, Amsterdam and Rotterdam, in which the government took over the system worked by a private company. Mixed systems, partly governmental and partly private, are found in Sweden and Norway. Purely state systems exist in Germany, Bavaria and Switzerland; Austria and Belgium have also acquired the plants started by private companies. Some brief information concerning a number of these plants is given. Editorially it is thought that the statistics have been selected for the purpose of attacking the English system.—Lond. *Elec.*, March 24.

Telephonic News Agency.—According to the Lond. *Elec.*, March 24, a company in Vienna called "The Telephone Herald" has acquired a concession for a telephone news agency in that city similar to the one already existing in Budapest. News will be communicated to subscribers by telephone at certain hours of the day, while at others music and other recitals will be provided.—Lond. *Elec.*, March 24.

REFERENCES.

Telephone Station Without Batteries.—The first part of a long illustrated description of an installation of his system including a number of improvements, in which there is no source of current at the subscriber's end of the line. The original description of his system was noticed in the Digest, March 6, 1897.—Ritter. *Elek. Zeit.*, April 6.

Party Line Telephony.—An illustrated description of a new system.—West. *Jour. Telegraphique*, March 25.

Wireless Telegraphy.—The beginning of an article which appears to be a sort of treatise, but which is to consist largely of abstracts from recent papers on this subject, all of which have been noticed in the Digest.—Voisenat. *L'Eclairage Elec.*, April 8.

Telegraphy.—A brief description of the new Baudot apparatus used on the Paris-Vienna line.—Tobler. *Jour. Telegraphique*, March 25.

MISCELLANEOUS.

REFERENCES.

A Cheap Form of Lightning Rod.—Dr. Bigelow, in the *Sc. Am.* April 22, states that a very cheap lightning rod for a country house may be made by nailing a few lengths of common barbed wire to the roof and carrying the wire down to an iron pump of a driven well. This gives an enormous number of points and an adequate earth connection. It has been in use for many years and apparently has been very effectual.—*Sc. Am.*, April 22.

Electrical Engineers in Building Construction.—A condensed reprint of a paper by Mr. Bradlee, read before the American Institute of Architects, is published in the *Eng. News*, April 13. It deals with the importance of engaging electrical, heating and sanitary engineers, besides the architects, in the construction of large buildings.—Bradlee. *Eng. News*, April 13.

New Books.

THE MODERN THEORY OF SOLUTION. Translated and edited by Harry C. Jones, Ph. D., Associate in Physical Chemistry in John Hopkins University. New York: Harper Bros. 134 pages, illustrated. Price, $1.00.

This little book belongs to the series of "Harper's Scientific Memoirs," edited by J. S. Ames, Ph. D., Professor of Physics in Johns Hopkins University. It deals with modern developments in the theory of solutions as appearing in important recent scientific papers, as follows:

"Osmotic Investigations," by Dr. W. Pfeffer, of Leipsic, 1897; "The Role of Osmotic Pressure in the Analogy between Solutions and Gases," by J. H. Van't Hoff, 1887; "On the Dissociation of Substances Dissolved in Water," by A. Arrhenius, 1887; "The General Law of the Freezing of Solvents," by F. M. Raoult, 1884; "On the Vapor-Pressure of Ethereal Solutions," Raoult, 1888; "The General Law of the Vapor-Pressure of Solvents," by Raoult, 1887.

A brief biographical notice of the author is given with each paper, an outline of the bibliography of the subject, and a general index. These chapters are translations from the original papers, and are valuable to the student as presenting the natural and historical development of the subject as displayed in these classical memoirs. These papers are certainly epoch-making in this department of science and will be of great interest to the student of physical chemistry.

BOOKS RECEIVED.

LIGHTING BY ACETYLENE. By William E. Gibbs, M. E. New York: D. Van Nostrand Company. 170 pages, 64 illustrations. Price, $1.50.

DAS ELECTROTECHNISCHE INSTITUT DER GROSSHERZOGLICHEN TECHNISCHEN HOCHSCHULE ZU KARLSRUHE. By Professor E. Arnold. Berlin: Julius Springer. 59 pages, 32 illustrations.

THE MANUAL OF STATISTICS. Stock Exchange Hand Book, 1899. New York: Charles H. Nicoll. 580 pages. Price, $3.

A TREATISE ON PHOTOGRAPHIC OPTICS. By R. S. Cole, M. A. New York: D. Van Nostrand Company. 330 pages. 103 illustrations. Price, $2.50.

MATERIALISTICH-HYPOTHETISCHE SATZE UND ERKLARUNG DES WESENS UND DER KRAFTAUSSERUNGEN DES ELEKTRISCHEN FLUIDUMS. Von F. Ph. Stögermayr. 2 vols. Wien: A. Hartleben's Verlag. 430 pages. 88 illustrations. Price, 3 marks per volume.

FORTSCHRITTE DER ANGEWANDTEN ELEKTROCHEMIE UND DER ACETYLEN INDUSTRIE IM JAHRE 1898. Von Franz Peters. Stuttgart: Arnold Bergstrasser's Verlag. 412 pages. 63 illustrations. Price 6 marks.

A Method of Motor Speed Control.

BY FREDERIC A. JOHNSON.

THE extreme wastefulness of controlling the speed of a direct-current electric motor on a constant potential circuit by means of a variable resistance in series with its armature is as well known as is the fact that when the field excitation is varied for that purpose, a much heavier and more costly field structure and

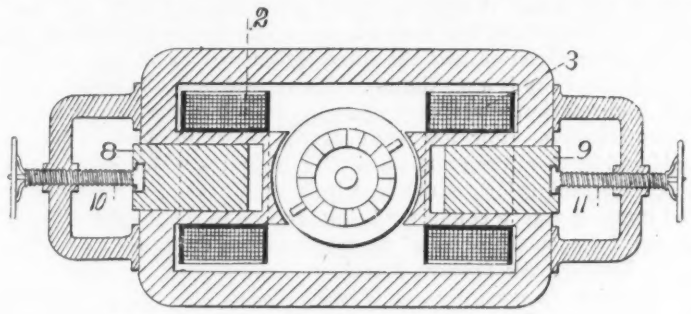


FIG. I.—JOHNSON METHOD OF MOTOR CONTROL.

an excessive exciting current are necessary in order that the motor shall not spark at high speed.

The writer has recently obtained letters patent upon a system intended to obviate these difficulties and which, in brief, consists in maintaining a strong and practically constant magnetic field at the pole-tips, where such is needed for sparkless commutation, while

the magnetism of the remainder of the pole face is varied to control the speed of the motor. This may be accomplished in various ways.

In Fig. 1 is shown a method particularly adapted to small motors. The pole pieces are hollow and the cavities are fitted with soft iron masses 8, 9, whose position may be adjusted by means of the screws 10, 11. When these masses are wholly or partially removed from the cavities, the total magnetic flux will be greatly decreased, thus raising the speed, while the magnetization of the pole-tips will still remain sufficiently strong for sparkless commutation.

Fig. 2 shows a method in which this result is attained by purely electrical means. The coils 8, 9, are so placed as to send lines of

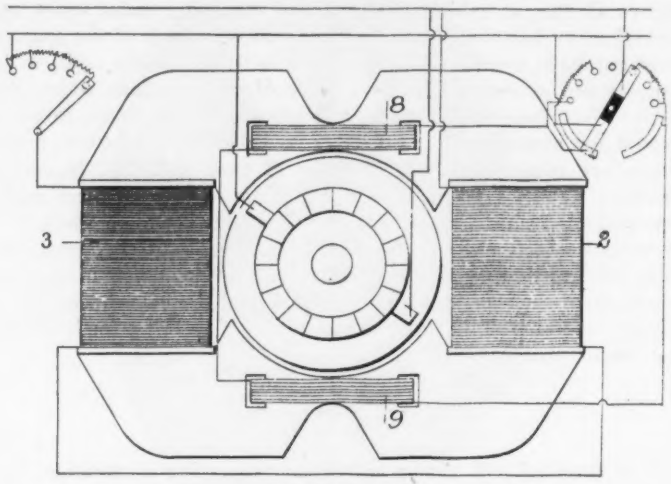


FIG. 2.—JOHNSON METHOD OF MOTOR CONTROL.

force through the centres of the pole-pieces and their effect on the pole-tips is slight. Now if a current, variable at will in direction and intensity, be passed through these coils, a wide range of speed may be obtained without sparking at the brushes. For, while the total flux will be greatly varied, the field in which the armature coils undergo commutation will remain practically constant.

A somewhat different device is shown in Fig. 3, where the coils 24, 25, 26 and 27 are so placed as to magnetize the pole-tips directly and are connected in series with the main field coils 2, 3, and in parallel with shunting switches 28, 29, whose action is as follows. While both of these switches are closed, the main field coils

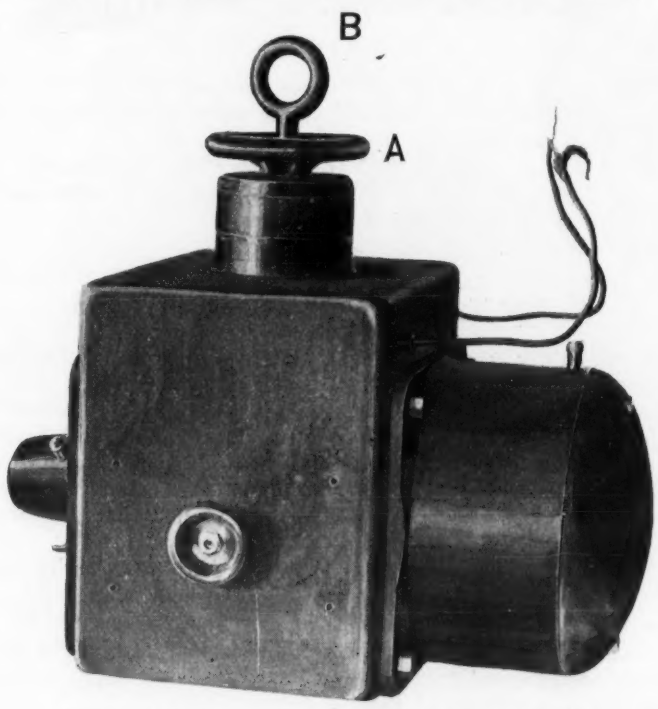


FIG. 4.—ONE-HP JOHNSON ENCLOSED SHUNT MOTOR.

are connected directly across the mains and the excitation is at a maximum. But when one of these switches is opened, the coils which it controls are placed in series with the main field coils and if the resistances and ampere-turns are properly proportioned, the total flux through the armature is greatly diminished, thus raising the speed, but the magnetizing effect of the auxiliary coils upon the pole-tips is such as to keep the commutating field constant and prevent sparking. The direction of rotation would determine which switch should be opened.

Some tests have recently been made of a one-horse-power, inclosed, shunt motor designed for connection to the Stow flexible shaft and which is shown in Fig. 4.

This machine was wound for 110 volts, the field current was 0.36 ampere. Its weight was about one-third less than that of the motor previously employed for a like purpose, having the same power, range of speed and general design, but whose speed was regulated by varying the field magnetism in the usual way.

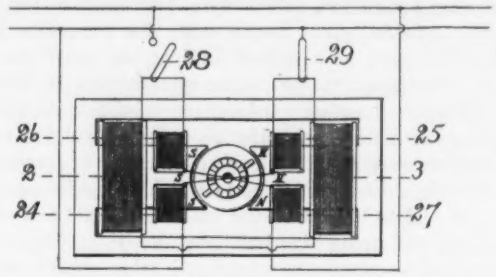


FIG. 3.—JOHNSON METHOD OF MOTOR CONTROL.

On account of its small size, the method of speed control shown in Fig. 1 was used. The cast-iron pole-piece being made hollow, inclosing a wrought iron plunger which could be raised by turning the wheel *A* or by lifting the eye-bolt *B*.

It was found that an elevation of about 2½ inches increased the speed from 830 to 1170 revolutions per minute, and that the motor would run sparklessly, in either direction, under all loads up to 50% overload, and at all speeds between the above limits, without changing the position of the brushes. Furthermore, while the motor was running under full load, the plunger could be suddenly lifted to its full height, thus instantly raising the speed by almost one-half, and, although the ammeter needle would momentarily register about 23 amperes, no sparks were perceptible at the brushes. This machine has been running under the most severe conditions for a considerable length of time and its behavior has been in every way extremely gratifying—in fact it has exceeded the expectations of all interested.

The Coming Electrical Exhibition.

Each of the Electrical Exhibitions held in this city of late years has been distinguished by some special feature. That of 1896 included the best public demonstration of the Röntgen Rays, the transmission of power from Niagara, and the sending of a cable message around the world. The Exhibition of 1898 included a complete church, lit by vacuum tubes; the application of electricity to street-car traction, the first series of wax works ever made to illustrate the history of an art, the theatrophone, and the beginnings of wireless telegraphy.

At the 1899 Exhibition the prominent feature will certainly be automobilism. The exhibit of electric vehicles will be by long odds the largest and best ever seen in America, and second only to the great exhibits at Paris. In fact, in many respects, it will surpass the displays of Europe, because it will illustrate particularly the application of electricity, and the vehicles shown will demonstrate the high perfection that the art has already reached in this country. This degree of excellence is proved by the fact that while there is no sale for European automobiles here, the manufacturers in America cannot ship machines fast enough to keep up with the demand.

This automobile exhibit bids fair to be a sensation in New York, illustrating as it will the wonderfully wide range of application carriages and wagons of every type being shown, with many special points of novelty and originality. It has been proposed, in connection with this exhibit, to organize during the show an automobile parade, making a characteristic function of it, after the style of those given in Paris through the Bois de Boulogne. It is believed that something of this character will be arranged while the National Electric Light Association is in session. The fact that to central station sources of supply this great new industry must look for the currents which it is to use, gives peculiar interest to the situation, automobile plants being already amongst the largest consumers that central light-

ing stations have upon their list of patrons. Several thousand square feet will be occupied by the exhibits of a large number of automobile manufacturers, and in this way a convincing proof will be given to the American public that the new industry is fairly launched on its career.

A great many other important features will be brought forward for the first time and in an improved shape at the Exhibition; but in view of the intense public interest manifested in wireless telegraphy the management have undertaken to organize exhibits in that line of work that will be unusually instructive. It will be remembered that in 1898, mines and torpedoes were exploded in the central tank of wireless telegraph methods, and other experiments of this nature are being planned for this year. But in order that the public may see the whole operation itself at a glance, and at the same time go away without any lurking suspicion of the genuineness of the feat, it is proposed to exhibit complete working sets of the apparatus on a long table of glass, the table itself being set up and insulated by blocks of glass, so that there will be a clear view under and around the apparatus. This table will be about 15 feet long, and messages will be sent from one end to the other, the sending signals and the response at the receiving end being heard at once. Visiting telegraphers, operators from the newspaper offices, and any other spectators will be allowed to send messages or signals themselves. The same apparatus will also be utilized in connection with the experiments for long-distance work, and a series of points have been selected, between which and the Garden it is proposed to exchange messages. In this manner, the public will have a better opportunity than has ever been afforded before of learning for itself the modus operandi of an invention which is stirring up the world of science no less than the outside public, fully as much as the Röntgen Rays did at the time of their discovery.

Several valuable government exhibits have been secured, and these will be grouped and attractively displayed. They include apparatus from the Army and Navy, the Signal Corps and the Weather Bureau, and will embrace also not a few interesting electrical relics of the late unpleasantness with Spain.

A special department will be also devoted to electrotherapy, the rapidly widening science of the application of electricity to medicine and surgery, in connection with which a great deal of elaborate apparatus has already been promised. It is the special aim and intention, in connection with this exhibit, to enable the public to learn for itself how far the science of electricity in the cure and prevention of diseases has gone. The utmost care is being taken to treat the subject on strictly scientific lines, and a committee of eminent specialists has been organized, whose names alone are a sufficient guarantee for the excellence of the work in this department. Another special section will illustrate the great strides made of late years in the application of electricity to dentistry. Here, again, the pervading relationship of the central station to the later branches of electricity will be emphasized, it being a fact that more and more of the practitioners who employ electricity in their work depend upon the power plants for their supply of current, with the intervention of motors and storage batteries.

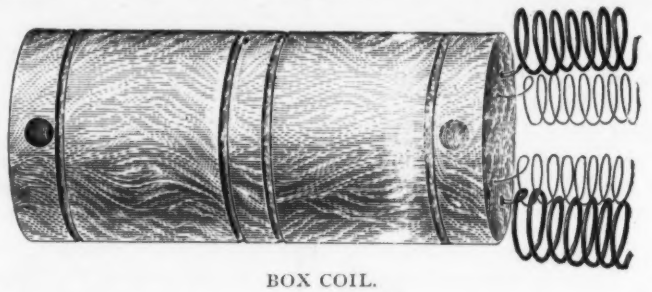
A number of spectacular exhibits are also being laid out, and elaborated by a committee at whose head is Mr. Luther Stieringer, whose work is so well known in connection with the electric exhibits at Chicago, Atlanta, Omaha, etc. This expert has also taken in hand the lighting of the Garden and will produce some entirely new effects, not only beautiful in themseles, but instructive as to the manner in which light should be used for the harmonious illumination of large spaces. A great many of the exhibitors are preparing features of extreme novelty and interest, to which attention will be called as soon as it is proper to do so.

It is a happy coincidence that this electrical exhibition in New York will be in progress at the time that the electrical exhibition opens at Como, Italy, to celebrate the centennial of the momentous discovery of the electric battery by Volta. The Italian exhibition opens on May 15, and it is proposed, therefore, to hold a special celebration at the Garden on Saturday, May 13, from which fraternal congratulations can be sent by cable. The New York Electrical Society, under whose auspices the exhibition of 1898 was given so brilliantly, has undertaken to organize the exercises of this function, and will rally to its aid on the occasion the assistance of other local and national bodies naturally interested in the matter, inviting also the co-operation of the Italian officials and societies. President Dunn and Secretary Guy are already at work on the matter, which commends itself generally to all who recognize how great is the debt which is owed to the famous Italian from whose work, it may be said, practical modern electricity dates.

Last year the basement was devoted almost wholly to exhibits on engines and boilers, and apparatus of that class. Although this was very successful, a great many of the exhibitors desired to be on the main floor. This has been accomplished in the present Exhibition by General Manager Nathan, and the basement will thus be available for a series of very interesting exhibits of a special nature, each of which will constitute a separate entertainment, and all of which will be free to the public. There will be an electric theatre of scenic models, the theatrophone, an electrical Cave of the Winds, an electric Grotto, an exhibit of the uses of electricity under water, and several other features of equal attractiveness. Such of the space as may not have been used in this way will be thrown open to inventors and patentees who have meritorious inventions which they wish to introduce to the public, and for which they desire to secure capital for exploitation. All likely to be interested in this opportunity are requested to communicate at once with Mr. Nathan at Madison Square Garden, who will arrange to provide them with a reasonable amount of space for their apparatus, and to assist them in every way to make an attractive demonstration at very small cost. It is believed that many worthy ideas and devices linger in obscurity for want of such an opportunity as this, and the experiment will be given a liberal trial, in order to see what it may bring forth of value and importance.

A New Box Coil.

The form of coil shown in the accompanying illustration is an improvement on a similar coil brought out by the same concern a year ago. This new coil permits of the use of one-gauge heavier wire on the secondary coil, which increases the efficiency of the coil without increasing the outside dimensions. The two screw holes,



BOX COIL.

which are separated by a fixed distance, are both in the cover of the box, thus insuring correct alignment, one screw passing through the head of the inner bobbin.

These coils are made by the Varley Duplex Magnet Company, 138 Seventh Street, Jersey City, N. J., in two sizes, viz., 2 inches and 4 inches long; each of 1⅛ inches in diameter.

A New Type of Electric Ventilating Fan.

Although the propeller or wing type of ventilating fan has been equipped with various types of electric motors, the design of these motors has hardly received the attention demanded by the importance of the work performed by such machines. The B. F. Sturtevant Company, of Boston, Mass., has of late been giving the entire subject very thorough investigation, and is now presenting an entirely new type of fan wheel and of direct connected motor, as shown by the accompanying engravings.

The wheel consists, in the size shown in the illustration, of eight blades, secured to a light but stiff hub, and held in their relative positions by a hoop at the periphery. The delivery edge of the fan wheel is helical, so that the air is picked up at the inlet edge at low velocity, and gradually accelerated to its maximum velocity with the least amount of slip.

The motor presents specially interesting features, and from the accompanying description it is clear that the design is the result of most careful study, with a veiw to fulfilling the following conditions:

(1) The production of a magnetic field of the greatest possible quantity in proportion to the rated horse-power. (2) The excitation of this field with the least possible consumption of energy. (3) Suitable material for poles to eliminate eddy currents and heat

loss therein. (4) Pole pieces of such design as to prevent distortion of magnetic field by armature flux and the consequent low reduction of the self-induction of the armature coils. (5) Arrangement of magnetic circuit, such that the leakage is small. (6) An armature in which the core and resistance losses are reduced to a minimum.

The first requirement is fulfilled by using soft and highly permeable sheet iron stamped to the required form and assembled

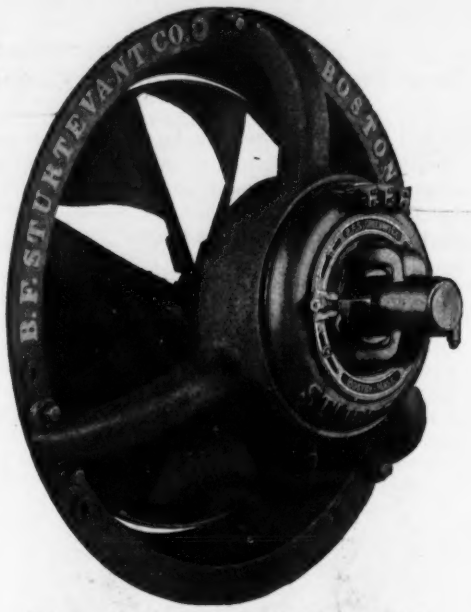


FIG. 1.—NEW TYPE OF VENTILATING FAN.

to the correct thickness. The use of laminated iron satisfied the demands of small exciting energy and eliminates eddy currents and heat losses in pole pieces. The shape of the pole pieces shown in the cut imposes so great reluctance to armature flux that its disturbing effect at full load is negligible, and at the same time lowers the self-induction of the armature coils by the fact of the pole pieces being saturated.

The conditions of small leakage of magnetic flux are met by having the poles, or parts in magnetic circuit, possessing great differences of magnetic potential, of small area and placing the exciting coils as close to the armature as possible. The observed leakage in this machine is stated to be less than one-half that of many of the types in use. To reduce the core losses, only the best quality of annealed sheet iron is used, the plates being japanned before assembling on the shaft to avoid eddy currents. The resistance and amount of copper on the armature core, is of course, comparatively small on account of having a magnetic field of great quantity as before mentioned.

By observing the conditions above enumerated in the design of this type of motor, the makers state that an efficiency of over 80 per cent. is obtained at brake, and this in a ½-kw 500-volt motor, running 1300 r. p. m. The sparking attendant on changes of load has been entirely eliminated so that a load of 175 per cent. of rated capacity of motor may be carried with absolutely no sparking, the position of brushes remaining unchanged. This feature combined with small temperature rise, allows of temporary overloads being carried with impunity. Though of the enclosed type, the temperature rise of the motor after 10 hours run is but 27 to 40 degrees, Fahr.

Referring to the cuts it is observed that the arrangement for supporting the brush-holders is a departure from existing methods and gives great rigidity to the brush-holders. The leads to the brushes are brought through from the rear, thus doing away with any dangling connecting wires. The brushes are of hard carbon in holders of a modified reaction type that allow of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. In such a case the field connections are reversed at the terminal block.

These motors are built in the two-pole type in sizes of from ¼ to 3-hp, and in a similar type, but multipolar, up to 20-hp. All of these motors are also built as independent machines, and are particularly convenient for the operation of small machines, tools and the like. The fan wheels with connected motors are constructed in sizes from 18 in. to 120 in.

FIG. 2.—VIEW OF VENTILATING FAN MOTOR AND END PLATES.

Insulation and Cable Testing Galvanometers.

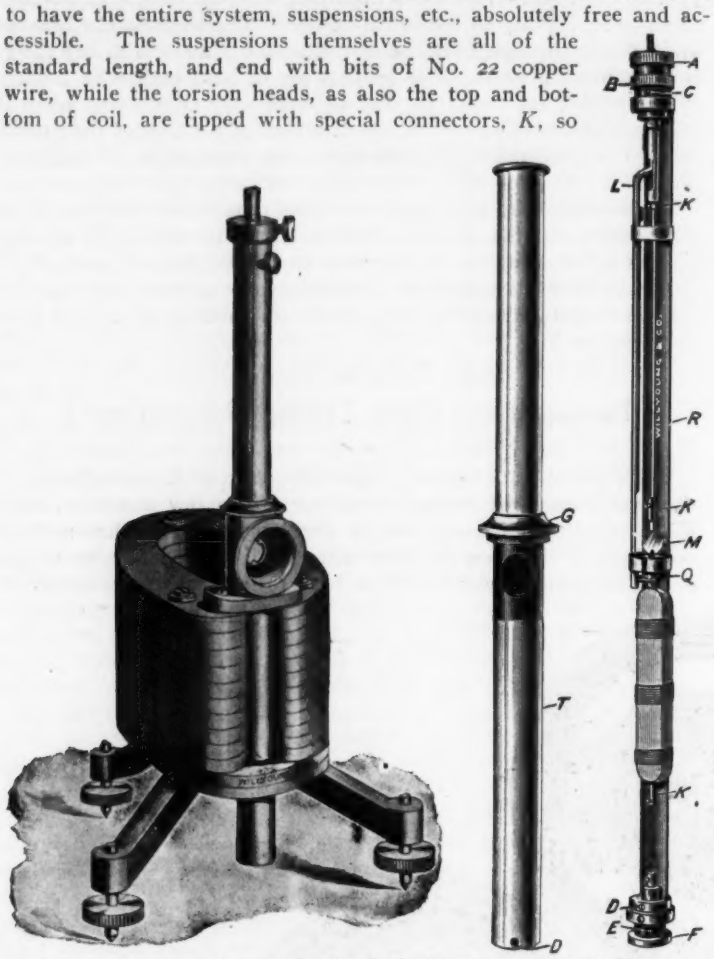
While a well-made voltmeter and a known e. m. f. are sufficient for the measurement of insulations of not over a few megohms, when the insulation resistances are in the hundreds and thousands of megohms, as is often the case when dealing with telegraph, telephone, light and power cables, such an instrument proves totally inadequate, not being sufficiently sensitive, and a sensitive galvanometer must be employed.

The D'Arsonval galvanometer possesses the necessary sensitiveness, and in addition is specially adapted for use by the practical man. As now made it can be extremely sensitive, extremely stable as regards disturbance by mechanical causes, and totally unaffected by all current except the one passing through it. Magnetic changes in the neighborhood do not affect it.

Messrs. Wilcoung & Co., Philadelphia, have recently brought out a new design of d'Arsonval galvanometer for which many interest-

ing claims are made. The instrument itself is shown in Fig. 1. The field is of laminated special magnet steel treated according to the most approved process to insure permanency while, at the same time, giving a field of considerable strength. The coil proper is contained in a tube which is removable from the magnet in the manner first suggested by Prof. Ayrton and Mr. Mather. Fig. 2 shows the tube and coil in section, and Fig. 3 the tube with sheath removed.

As shown, the tube, so-called, consists of a rib, R (Fig. 3), by which are supported the top and bottom torsion heads. A straight fibre above, and helical spring fibre below, furnish torsion and carry current in and out at the same time. Over the whole slips the sheath, T, which, when in place is secured against withdrawal by the screw, D (Fig. 3). The sheath thus easily and instantly removable, is claimed as one of the greatest points of superiority over previously conceived instruments. In case of an accidentally broken suspension, one needs but remove the screw, D, and slip off the sheath, T, to have the entire system, suspensions, etc., absolutely free and accessible. The suspensions themselves are all of the standard length, and end with bits of No. 22 copper wire, while the torsion heads, as also the top and bottom of coil, are tipped with special connectors, *K*, so



FIGS. 1, 2 AND 3.—NEW DESIGN OF D'ARSONVAL GALVANOMETER.

made as to just contain the No. 22 wire; a small set screw is then tightened and holds them securely.

Another feature is the clamp for locking the system against accident, and taking the strain from the suspension. Through the centre of the upper torsion head runs a spindle, or wire, L, at the top of which is a milled head, A. This spindle (Fig. 3), is bent out as shown and finally terminates below in a little fork just under the disc, Q. The head, A, will therefore raise L, and hence the coil by the disc, Q, until jammed tightly against the holed-out stop above. It should be noted that the clamp spindle passes through the suspension spindle itself; each therefore moves quite independently of the other.

The mirror, M (Fig. 2), is attached to a little slip of foil and may be bent to any desired angle; it lies in the exact central plane of the system. The coils are wound with great care, of the purest obtainable copper wire covered with white silk. Every effort is made to keep iron away from contact with the system. The suspensions are of flat phosphor bronze and are most carefully annealed so as to be free from drift.

These d'Arsonval galvanometers are furnished with tubes either dead-beat or ballistic, and as the tubes may be interchanged very quickly and without interference with connections, it follows that an instrument with two tubes is adequate for both insulation and capacity work. The sensitiveness of the tubes may be varied up to 1500 or 2000 megohms, i. e., one scale division for 100 volts through 150,000 to 200,000.

Besides supplying these instruments as parts of laboratory outfits, Messrs. Willyoung & Co. are also putting them into portable cable testing sets for street service; in this form they are equipped with a telescope and scale permanently attached and are mounted in oak or cherry boxes with sling straps, etc. Mr. James G. Biddle, 1038 Drexel Building, Philadelphia, is selling agent for the Willyoung apparatus.

New Forms of Weatherproof Sockets.

Insulation at points of connection in damp situations and out of doors is a matter that cannot be too carefully looked after, and the best appliances are none too good where close attention is paid to avoid leakage.

The accompanying illustration shows a new socket just placed upon the market by the Bryant Electric Company, of Bridgeport,

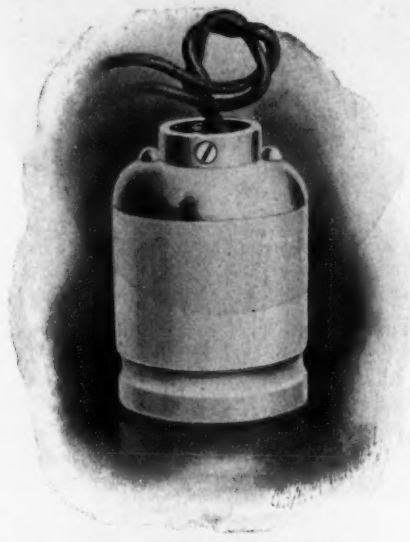


FIG. 1.—BRACKET SOCKET.

Conn. It is called the Bryant Bracket socket, and is designed for installations requiring weatherproof sockets. The top is fitted with a polished brass cap, which is made in one-eighth inch for chandelier or fixture work, and three-eighths inch for outdoor use on gas pipe brackets. This socket, and the one shown in Fig. 2, which

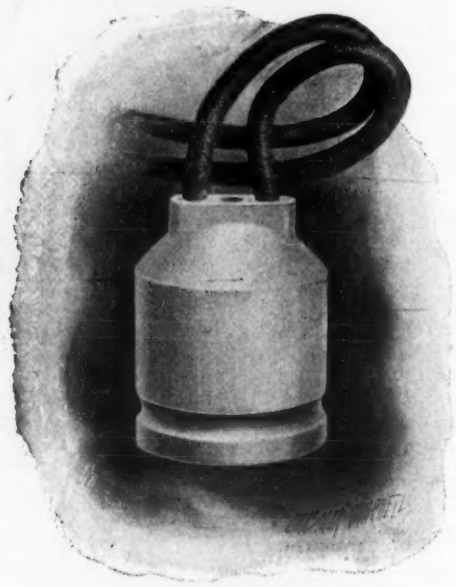


FIG. 2.—WEATHERPROOF PENDANT SOCKET.

is a new form of the Bryant weatherproof pendant socket, are adapted for use with a shade holder, the groove at the lower opening taking a holder of special design.

These sockets are furnished for Thomson-Houston, Westinghouse and Edison bases.

NEWS OF THE WEEK.

Financial Intelligence.

BELL TELEPHONE COMPANY of Philadelphia has declared its quarterly dividend of 2 per cent.

BOSTON EDISON DIVIDEND.—The Edison Electric Illuminating Company of Boston has declared its regular quarterly dividend of 2 per cent., payable May 1.

THE PAN-AMERICAN EXPOSITION COMPANY has certified to the secretary of state, New York, that the capital has been increased from $1,000,000 to $2,500,000.

ELECTRIC STORAGE.—A special meeting of the stockholders of the Electric Storage Battery Company has been called for May 4th at noon, to vote on a proposed increase of $4,500,000 on the common stock of the company, making the total stock capitalization $18,000,000.

COLUMBIA AUTOMOBILES.—The deal between the Pope Manufacturing Company and the Electric Vehicle Company, announced in these pages last week, and referred to several times, for the manufacture and use of Columbia automobiles, is understood to have been closed on Tuesday. The capital of the new company will be $3,000,000, as already stated.

ELECTROLYTIC MARINE SALTS COMPANY.—It has been determined to declare a dividend in liquidation of 20c. per share to stockholders of the Electrolytic Marine Salts Company, payable May 1. Further dividends will be paid as litigation against the company is settled. A dividend of 30 cents per share is declared to be in sight, with 35 cents a probability. This was the Jernigan swindle.

GENERAL ELECTRIC DIVIDEND.—It is stated on good authority that General Electric stockholders will get in the near future something better than 1¼ per cent. quarterly dividend. Some think this will come in shape of a higher rate of regular distribution, while others think it will be in form of an occasional addition to regular distribution at the rate of 5 per cent. Part of the recent buying is understood to be based on this expectation.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—Cumberland Telephone & Telegraph Company bonds are now quoted at 111½, yielding a 4⅛ per cent interest return. The company's earnings have exceeded expectations. For the year ended March 31 it earned $887,706 gross and $381,340 net. Its interest charge amounts to about $50,000 per year. The company has recently doubled its capital stock to $6,000,000. The American Bell Telephone Company owns 45 per cent. of the stock of this company.

COPPER PRICES.—The market for copper was active last week, and it was difficult to get metal for early deliveries. Lake copper commands about 18¾ cents, and it is reported that 19 cents has been offered in one or two cases. It is reported, though not confirmed, that the Calumet & Hecla Company is now sold for several months ahead, and is taking no more contracts. Electrolytic was selling at 17⅞ cents. to 17⅜ cents and casting copper was nominal at 16¾ cents. The London market has been strong with a steady advance all through the week, and on Thursday £76 15s. was paid for spot. A $400,000,000 copper mining combination is now spoken of.

SUBMARINE CABLE STOCKS DOWN.—A despatch from London of April 22 says: The reported developments in wireless telegraphy have given an opportunity for a successful onslaught upon the stock of cable companies on the London Stock Exchange this week. Expert opinion here, however, is sceptical regarding Marconi's system ever being applied to cross-Atlantic work, and Marconi himself is careful not to guarantee that it would succeed. Anyway, he does not intend to try trans-Atlantic work at present, as the initial outlay would be large. He is busy daily at Dover perfecting the working of his appliance across the English Channel and has made very many improvements, which insure the success of his sixty-nine-mile trial shortly from Dover to Dieppe.

WASHINGTON TRACTION AND LIGHT DEAL.—The Washington Gas Company has been absorbed by the street railway and lighting syndicate headed by Mr. Frederick C. Stevens, which recently bought up all but one of the street railways of the city, and also the electric light companies. The gas deal proposition made to the stockholders contemplates the purchase of the entire issue of stock, something over 120,000 shares, at $60 per share. The proposition was made by ex-Senator Gorman on the part of the syndicate, which also includes ex-Senator Smith of New Jersey. John C. Bullitt of Philadelphia, where about 30 per cent. of the stock issued is held, acted for the stockholders. The remainder of the stock is held in Washington.

GARVIN MACHINE COMPANY.—Harriman & Co. offer for subscription at par and accrued dividends from April 1, 1899, $2,000,000 7 per cent cumulative preferred stock of the Garvin Machine Company. This company was incorporated under the laws of the State of New York, in 1889, to manufacture tools and machinery, and the limit of capitalization was $1,000,000, upon which the company has earned, net, annually for the past nine years, 46 per cent. The business of the company has grown beyond its ability to meet the increased demand for its product, and in order to supply the additional capital the entire net proceeds from the sale of this preferred stock go directly into the company's business. The preferred stock offered for sale is entitled to preferential cumulative dividends of seven per cent. per annum to be provided for out of the net earnings of the company before any dividends are paid upon the common stock, and the preferred has priority over the common in respect to all property and assets of the company. The company reserves the right to retire the preferred stock on April 1, 1904, at 105 and accrued dividends to that date.

NORTH AMERICAN.—The advance in North American is explained by the statement of earnings of the Milwaukee Electric Railway. This statement shows that dividends can easily be paid on Milwaukee Electric stock, and inasmuch as North American owns over $5,000,000 of this stock it amounts practically to a small dividend on North American stock. Milwaukee Electric will eventually control the street railway lines of Kenosha, as a result of developing its system of interurban lines. There has been a good deal of trouble over the franchise for a line to run through Kenosha and beyond, and litigation is expected, but there is little doubt that the Milwaukee company will carry out its plans. The net earnings of the Milwaukee Electric Railway & Light Company for the year of 1898 were $780,910, against total interest charges of $380,150, leaving a surplus of $400,760 6 per cent. dividends upon the preferred stock amount to $210,000, leaving a surplus of $190,760 for the common stock or about 5 per cent. At the present rate of increase the common is earning over 8 per cent. The North American company owns a large majority of both issues of stock.

THE WEEK IN STOCKS has been one of general dullness, with many declines and a few advances, total sales of shares falling off about 700,000, as compared with the previous week, while the investment demand for bonds was excellent. During the week, in New York, Western Union on sales of 11,909 shares, declined to 92¾. General Electric on dividend rumors and sales of 18,422 shares, rose 2½ points to 119. Metropolitan Street Railway, on sales of 31,295 shares, declined from 255 to 251. Manhattan Railway, on sales of 141,057 shares, broke 3½ to 123⅞. Brooklyn Rapid Transit on the large transactions of 278,750 shares, declined 4 to 131. In Boston, Bell Telephone closed the week at 363 and Erie Telephone at 95. West End Railway at 95, New England at 145 bid. All the copper stocks there were active and strong. In Chicago, National Carbon, common, was quoted at 24, and Union Loop at 61. Among the "unlisted" stocks in New York Electric Vehicle, common, was quoted at 139 to 144 and pref., at 140 to 144. Electric Boat, common, at 32 to 34, and preferred, at 56 to 57. General Electric Automobile at 25 to 30. Otis Elevator, common, 34 to 36, and preferred, 89 to 90½.

ELECTRIC TRACTION COMPANY is a recent comer in Philadelphia, where it seems already to be in high favor. The business of the company will be confined strictly to the purchase and control of existing electric railways throughout the country. It will not enter the field of electric lighting and power, and will therefore not compete with the Electric of America. In explanation of this, we are informed that the policy of the new company will be on similar lines to the Electric Company of America and U. G. I. In other words, the new traction company will stand in the same position as the two last named companies as regards their particular line of business, each having its own field, that of the new company being strictly confined to the electric railway business. The capital of the new company will be $25,000,000, dvided into 500,000 shares of par value of $50; 250,000 shares will be issued at once on which the first installment will be $5 per share; the balance, 250,000 shares, will remain in the treasury; the first call of $5 will give the company $1,250,000 with which to begin business. The 250,000 shares treasury stock will be issued as occasion requires. The same people who are the predominating factors in Electric Company of America, Pennsylvania Manufacturing and U. G. I. will take the control of the property of the new Electric Traction Company.

CONSOLIDATED TRACTION OF CHICAGO.—This stock, listed on the New York Stock Exchange last week, is getting active on rather large transactions. It represents a combination of most of the street railway interests in that city. The principal companies taken into the combination are the Chicago Electric Company; North Chicago Electric Railway Company; The Chicago & North Shore Street Railway Company; North Side Electric Street Railway Company; Evanston Electric Railway Company; Cicero & Proviso Street Railway Company; Ogden Street Railway and the Chicago & Jefferson Urban Transit Company. The lines of the new company extend over the entire north, northwest, west and southwest portions of Chicago and connect at their terminal points with the North and West Chicago Street Railways. The line has 206.60 miles of tracks and an equipment of 269 motor cars, 162 trail cars and 208 motor equipments, together with necessary snow-plows, sweepers, etc. The Chicago Consolidated Traction Company paid for its purchases with stock in the new company, the stockholders of the selling companies surrendering to the new company the stock they held in those properties. These certificates are practically valueless, except to continue the organizations and keep alive their charters. The total amount of the stock of the seller companies was $12,500,000, for which there was given $14,500,000 stock of the new company. The rest of the stock, $500,000, was sold for cash, part of which was used to pay off the obligations of the seller companies, and the balance, $200,000, is in bank. The capital stock of the company is 150,000 shares of the value of $100 each. The gross earnings of the company in 1898 are $1,026,780; net earnings $406,292 and surplus $68,834.

THE STATE OF TRADE.—In their review of last week, R. G. Dun & Co. say: Nothing appears in business or in money markets to prevent continuance of the heaviest trade ever transacted at good profits. The payment to Spain is supposed to have caused some rise in foreign exchange, which would amount to nothing in any case as balances due from other countries more than cover the payment, and advance bills against crops to come forward in July and later will soon be offered. Loans on industrial securities are still at higher rates than on railway stocks, but on good commercial paper or railroad stocks money is in ample supply and at low rates. Nor have stock operations caused any appearance of pressure. The financing of new corporations has passed thus far with less trouble than had been feared, though the completion of some organizations is hindered or has failed. The usual time for financial troubles in the spring has passed, and the usual alarm about crops has done its work and still industries are undisturbed. Some shrinkage in railroad earnings is natural because of the smaller movement of bulky products, and in half of April the earnings were but 6.1 per cent. larger than last year, and 13.6

per cent. larger than 1892, running rather behind those of March. The trunk lines only show loss in comparison with either year. Chicago eastbound tonnage is 13 per cent. less than last year, and 5 per cent. less than in 1892 for that reason. The one hindrance in stock speculation is doubt about the crops, but better unofficial reports have supported inferences warranted by the heavy receipts from the farms in the West and South. Failures are small, in two weeks of April only $2,812,847, against $4,865,470 last year, and $6,148,055 in 1897. Manufacturing were $1,020,959, against $2,952,066 last year, and trading were $1,303,174 against $1,610,167 last year. Failures for the week have been 184 in the United States, against 204 last year, and 22 in Canada against 29 last year.

Special Correspondence.

NEW YORK NOTES.

NEW YORK ACADEMY OF SCIENCES gave last week at the Museum of Natural History, its sixth annual exhibition and reception. The electrical section, under the charge of Prof. G. F. Sever, of Columbia, was interesting, but did not contain many novelties of interest except to the general public. The new Queen photometer was part of the display.

TELEPHONE RATES REDUCED.—The New York Telephone Company has announced a reduction in rates. For 600 local messages the price will be $75 instead of $90, as formerly; for 700, $81 instead of $98; for 800, $87 instead of $106. Additional local messages will cost 8 cents each up to 1800; from 1200 to 1800, 7 cents each; to 2100, 6 cents each; to 4500, 5 cents each. The new rates do not apply to the Borough of the Bronx.

THE CONEY ISLAND & BROOKLYN RAILWAY.—It is stated that negotiations for the purchase of the Coney Island & Brooklyn Railway have been renewed by the Brooklyn Rapid Transit Company. The Coney Island road is the only one in Brooklyn which has not passed under the control of the Rapid Transit Company and it is likely that the negotiations now being conducted will be successfully carried out. The DeKalb Avenue line of this company is said to be one of the most profitable in the country.

THE J. G. WHITE COMPANY, of this city, has purchased the San Juan & Rio Piedras Railway Company in Puerto Rico, and has already commenced the work of changing the motive power from steam to electricity. Mr. W. H. Harrison, secretary of the company, states that the change of equipping the 8¾ miles of line would involve an expenditure of $500,000. A franchise has also been secured from Gen. Henry, the military governor of the island, for building three-quarters of a mile of railway in the city of San Juan. It is expected that the line will be built in six months. The J. G. White Company will also organize an electric light system for San Juan. To secure the right to light the city the consent of the War Department at Washington will be necessary, and it is expected that the decision of Secretary Alger in this matter will be rendered in a few days.

WESTERN NEW YORK NOTES.

ELECTRIC LIGHT CARBONS FOR BATAVIA.—Batavia's Board of Aldermen has ordered from a Cleveland firm 70,000 electric light carbons at $12.77 per 1000, with a 2 per cent. reduction for cash.

THE BUFFALO FORGE COMPANY has secured the contract for the electric light plant for the United States Transport Panama. This ship will carry a duplicate set of all the principal parts of the installation.

THE INTERNATIONAL TRACTION COMPANY held a meeting in Toronto and took over the Canadian property which the syndicate has purchased. This includes the Niagara Falls Park & River Railway. Officers were elected.

REDUCING RATES FOR INCANDESCENT LIGHTS.—The Buffalo General Electric Company announces that on May 1 it will make a reduction in the price of incandescent lights, but as yet the schedules have not been completed.

ELECTRIC LIGHT PROPOSED FOR WILSON, N. Y.—Mr. J. J. Miller, of Pittsburg, Pa., who has a summer home at Wilson, N. Y., is talking of establishing an electric light plant in Wilson and also connecting that village with Youngstown by an electric railway.

CHARLOTTE, N. Y., LIKES MUNICIPAL LIGHT AND WANTS MORE.—Charlotte, near Rochester, is so well pleased with its new arc light installation that it will submit the question of bonding the village for an additional $6,000, the money to be used to establish an incandescent system.

STORAGE BATTERY FOR FIRE TELEGRAPH.—The Buffalo Fire Department has contracted for a large storage battery for the fire alarm telegraph service. The battery will consist of 1500 cells of 15 ampere hours' capacity, and will be divided into two sections of 750 cells each, so that one section may be charging while the other is in use.

A BILL has been introduced in the Legislature at Albany by Senator Ellsworth, to allow the construction of a surface railway along the Riverway in Niagara Falls, this street being a portion of the New York state reservation at Niagara.. The length of the proposed line is only one block, but its construction would be a material relief to the congested condition of trolley traffic on Falls street.

THE BELL TELEPHONE COMPANY announces that it will build a fine new business block and exchange in Rochester. The new building will be located on Fitzhugh street, nearly opposite the postoffice. It will have a frontage of 66 feet and a depth of 80 feet, and will be three stories high and fireproof. An outlay of $50,000 will be represented in the building. Contracts are to be let in twenty days.

FROM BUFFALO TO QUEENSTON BY ELECTRIC RAILWAY.—Mr. Burt Van Horn, general manager of the International Traction Company, is quoted as stating that his company will maintain a through line between Buffalo and Queenston, Ont., the route to be over the Buffalo & Niagara Falls tracks to the Falls; over the upper steel arch bridge, and down the gorge over the tracks of the Niagara Falls Park & River Railway to Queenston; all this without change of cars.

BUFFALO GENERAL ELECTRIC COMPANY.—The new Edison three-wire system has just been put into operation. This is intended to ultimately supply all light and power in the business centre of the city. All distribution is underground, by lead covered rubber insulated cables in vitrified tile conduits and now consists of 30,000 feet of million cm cable and 13,000 feet of 500,000 and 350,000-cm, with 10,000 feet of pressure wires. The generating plant now contains two 100-kw rotary transformers and there are ordered for this system a storage battery having output rate of 750-kw for three hours and a charging set consisting of one 425-kw, three-phase synchronous motor direct coupled to two 200-kw, direct-current generators at 120 to 190 volts guaranteed to endure 50 per cent. overload for a short time.

THE PAN-AMERICAN EXPOSITION.—Negotiations are being carried on with the various states for State buildings and exhibits and many of them have appropriations for such purpose pending. A bill appropriating $50,000 for state exhibit has just been favorably reported by the ways and means committee of the Michigan House of Representatives. Committees will visit Massachusetts, Connecticut and Missouri to secure appropriations. The committee on law has formulated an opinion that exhibits cannot be accepted from Europe and Asia, but must be confined to the western hemisphere. It has been decided to form a bureau of labor registration, and, as far as possible, give preference to workmen who are residents of Buffalo and towns in the immediate vicinity. A name is wanted for that district in which the amusements are collected as in the "Midway" at Chicago—a name that is particularly catchy and apt. Suggestions will be received.

BUFFALO, HAMBURG & AURORA RAILWAY.—Mr. U. L. Upson, general manager, gives out the following statement: Contract for the complete construction and equipment of the road has been let to the Continental Construction Company of Boston, H. N. Bates, general manager. Orders have been placed with the Cambria Steel Company for girder rails for use in Hamburg village and in Chicago for 600 tons of 60-lb. T-rails, spikes, joints, etc. A large quantity of ties has been delivered and 8000 more are to be delivered May 1. It is expected to begin work on the power station and car house about May 1. These will be at Benzing's Crossing near Orchard Park. It is proposed to have the line in operation between Buffalo, Hamburg and Orchard Park on or about Aug. 1, with an equipment of six passenger cars. Negotiations are in progress with persons along the line, to handle freight. This line will connect with the Abbott's Corners Road line of the Buffalo Railway Company, and cars will be run into Buffalo over the tracks of the latter railway.

INDIANA NOTES.

THE CARMELTON ELECTRIC LIGHT & POWER COMPANY, of Carmelton, Ind., has filed articles of incorporation, with a capital of $13,000.

REDUCTION OF INTERURBAN RATES.—The Board of County Commissioners for Marion County at Indianapolis reduced the proposed charges heretofore set out by the several interurban electric lines to one and two-fifths of a cent per mile.

DAMAGES FOR DISCRIMINATION.—Judge Kirkpatrick, of Spokane, Ind., awarded A. B. Irvin, cashier of the Farmers' National Bank judgment against the Co-operative Telephone Company for $1,000 because of alleged discrimination. The company shut off Irvin's residence telephone last July for alleged failure to pay rent. Irvin claimed that he did not owe it, that the company owed him, and that he made several demands before he was reconnected, recovering $100 in each case. Since obtaining the judgment Irvin has been elected director and general manager of the company against which he obtained judgment.

ELECTRIC LIGHT IN JEFFERSONVILLE, IND.—Bids for furnishing Jeffersonville, Ind., with electric light were recently opened. There were at least twenty competitors. The most favorable proposition is thought to come from the Ft. Wayne Electric Light Company, which offers to furnish street arc lights at $50 per annum each, the city to furnish ground on which to erect a $40,000 plant, pay 3½ per cent. on the investment and at the end of ten years take possession of the plant for nothing. The new contract will call for service from sundown to sun-up. The city is now paying $90 per lamp for very inferior service, which ends at 12:40 each night.

THE INDIANAPOLIS & PLAINFIELD ELECTRIC TRACTION COMPANY was formed on April 20, with a capital stock of $100,000. Articles of incorporation will be filed in a few days. The company will build and operate an electric line between Indianapolis and Plainfield, a distance of twenty-one miles. The following directors were elected: P. D. Erwin, D. M. Parry, D. M. Ransdall, H. C. Adams and George Webster, of Indianapolis, and Talor Reagan and Oscar Hadley, of Plainfield. The company will enter the city of Indianapolis over the tracks of the Indianapolis Street Railway Company from Mt. Jackson, a distance of four miles.

THE INDIANAPOLIS & LOGANSPORT TRACTION COMPANY, which proposes to construct an electric line from Indianapolis to Logansport, is experiencing much trouble in Clinton County. The commissioners of that county were enjoined from granting the traction company a franchise through the county, and now that the injunction has been dissolved, the board is slow in acting. It is said that this method is being pursued in order to afford a Frankfort company to obtain such rights as will enable it to exact tribute of the traction company. It is absolutely necessary to the success of the company to get a right of way through Clinton County.

CHICAGO NOTES.

MESSRS. SARGENT & LUNDY, of this city, will on May 1, move their offices from 13 Monadnock Block to 1140 the same building.

ELECTRIC POWER IN PRINTING.—Messrs. Hollister Bros., No. 148 Monroe street, Chicago, art printers and publishers of posters, are installing a number of Western Electric Company motors in their pressroom.

COMPRESSED-AIR TRACTION.—On Saturday evening, between midnight and 4 a. m., experiments were made on the North Chicago Street Railway, with a compressed-air car. It is the intention to continue the experiments.

ELECTRICITY IN PRINTING.—R. R. Donnelly & Sons Company have increased their electrical generating plant by the addition of another Western Electric generator. Every machine and printing press is now operated by electricity.

A HOTEL ISOLATED PLANT.—The Great Northern Hotel, which for many years has been supplied with current from a central station, has recently transferred its load from street mains to its own plant, which consists of three 150 k. w. Western Electric generators.

EMERGENCY CUSTOMERSfi—A well-known pharmacy at the terminus of the 47th Street line, has adopted an enterprising scheme for the benefit of customers wishing to make a purchase while waiting for a car. At a number of places throughout the store are push buttons, and when a customer rushes in wishing to make a purchase and not miss his car, one of these buttons is pushed, whereupon if all of the clerks are engaged with customers or compounding prescriptions, one will drop his work immediately to attend to the hurry call.

THE CITY'S NEW ELECTRIC LIGHT PLANT.—City Electrician Ellicott is seeking a location for the new $80,000 electric light plant which the city is going to erect in the vicinity of Halstead and 60th streets. The plans have been drawn and part of the machinery has been purchased. This plant will supply light for which the city has hitherto been paying a private company. The lights cost the city $107 a year each. The new plant will have an ultimate capacity of 1000 arc lights and will be fitted out at once to supply 500. The 14th Street station will be abandoned after the new plant has been constructed.

ST. LOUIS NOTES.

ELECTRIC LIGHT TROUBLES IN CARTHAGE.—Judge Thayer, of the United States Circuit Court, has refused to interfere in the fight of the Jasper County Electric Light Company against the city of Carthage, Mo., over a lighting franchise. The company claimed that a franchise granted to it in 1885 was to run 20 years, and asked for an injunction to restrain the city from constructing a lighting plant in violation of its contract.

FINISHING THE DAY ELECTRIC RAILWAY.—The taking off of the accommodation trains between Belleville and St. Louis has caused much anxiety among the people who travel regularly between the two places, as to when the double track Day electric line will be in operation. Two shifts of men are now at work giving the track the finishing touches, and it is announced that within a very few days the line will be in operation.

TEXAS AND MEXICO NOTES.

NEW STREET RAILWAY FOR FORT WORTH.—A company is being formed at Fort Worth, Texas, to build a street railway around the eastern part of that city.

AN ELECTRIC LIGHT PLANT FOR URES, MEXICO.—August Moerlin, a German electrical engineer, has organized a company of capitalists in the town of Ures, State of Sonora, Mexico, to establish an electric light plant there.

PRESIDENT CHARLES J. GLIDDEN, of the Southwestern Telegraph and Telephone Company, whose headquarters are at Lowell, Mass., has just completed his annual tour of inspection of his Texas lines. He is well pleased with the situation in that State. The company has made some important extensions in Texas during the past twelve months, and many more new lines are contemplated.

WATER FOR AUSTIN'S INACTIVE MUNICIPAL PLANT.—Recent heavy rains are causing a rise in the waters of Lake McDonald, which furnishes the water power for the operation of the municipal electric light and power plant at Austin, Texas, and it is expected that the operation of the plant will be resumed in a short time. The plant has been shut down for several weeks, causing complete darkness in the city.

ELECTRIC LIGHTING IN DALLAS.—Judge Richard Morgan of the Dallas, Texas, District Court, has issued a writ of temporary injunction restraining the city of Dallas from carrying out any contract with the Dallas Electric Company, making the writ returnable April 29. The injunction was granted at the instance of the Standard Light and Power Company, which entered a bid for lighting the city at a figure of $3,000 per annum less than that of the Dallas Electric Company. The stockholders of the Dallas Electric Company are principally Boston, Mass., capitalists.

EXTENDING THE TELEGRAPH IN MEXICO.—The Federal telegraph system of Mexico, which is owned and operated by the government of that country, is being rapidly extended to the most remote regions of the Republic. New lines have recently been completed, which connect the city of Mexico with the extreme southeastern parts of the country along the Guatemalan border. The work of constructing lines in the Sierra Madres is very difficult but it is being carried on as rapidly as possible, and many of the remote mining camps are already in telegraphic communication with the outside world.

ELECTRIC RAILWAY DEVELOPMENTS IN HOUSTON.—The Houston Belt and Magnolia Park Street Railway, of Houston, Texas, is soon to be placed in operation. The road, with the exception of the portion which was formerly a part of the LaPorte railroad, has not been used for four years, during which time it passed out of the hands of Receiver John Kennedy into those of its present owners. That portion of the line extending from Houston to the suburb of Oak Lawn, a distance of two miles, will be equipped with electricity.

PATERNAL GOVERNMENT IN TEXAS.—A bill has been introduced in the Texas Legislature, and has already passed the House of Representatives, which authorizes the City Council of all cities and towns incorporated under the general laws of the State to regulate the charges and fix the rates to be charged by all telephone and telegraph companies and all other corporations or persons engaged in supplying commodities to the public, or engaged in any other public business within the limits of said cities and towns. It is one of the most far reaching measures introduced during the present session of that Legislature.

THE TEXAS ANTI-TRUST LAW.—The quo warranto cases against the San Antonio Gas Company, the Mutual Electric Light Company, the San Antonio Street Railway Company and the Edison Street Railway Company, all of San Antonio, which were filed a short time ago by Attorney General T. S. Smith, of Texas, for the forfeiture of the companies' charters and appointment of receivers, on the ground that they had combined to control prices and trade in violation of the anti-trust law, are now on trial at San Antonio, and the result is awaited with no little interest by the corporation interests of Texas and outside financial men who have capital invested in that State. The trial of the cases will occupy several days.

PACIFIC COAST NOTES.

WELDED RAIL JOINTS IN PORTLAND.—The City & Suburban Railway company has decided to weld the rail joints of its electric street car lines in Portland, Oregon.

THE BUTTE COUNTY ELECTRIC POWER & LIGHTING COMPANY was recently incorporated, with San Francisco as the principal place of business. The directors are: S. C. Denson. O. W. Meysenberg, W. E. Palmer, H. W. Snow, T. J. Ryan, San Francisco. The capital stock is $60,000.

THE SNOQUALMIE FALLS POWER COMPANY, of Seattle, Wash., having failed to make favorable terms with the authorities of Tacoma, will bring suit to compel the Pierce County Commissioners to grant a right of way to Tacoma. Electric power will be transmitted to both Seattle and Tacoma by this company.

LIGHT BONDS PURCHASED.—The Healdsburg, Cal., $80,000 bond issue, the validity of which has been questioned since the election of a year ago, was recently bought up by Mr. E. D. Shepard, 31 Nassau Street, New York. Forfeit money has been deposited on these light and water bonds, and if no flaw be found, the balance of purchase price is to be paid on May 1.

ELECTRIC LIGHTING WAR.—A rate war has broken out between the three electrical lighting companies doing business in Los Angeles, Cal. The base rate for lighting purposes in that city has been 15 cents per 1,000 watts, and for business purposes the discount has heretofore been 33⅓ per cent. At the last account the discounts had been increased to 70 per cent., and it was thought that the minimum had not been reached. The cause of the war is the introduction into the city of the two extensive currents of the San Gabriel Power Company and the Southern California Power Company, the latter being controlled by the Edison Company. These two currents are generated by the power of the Los Angeles and Santa Ana River. Their introduction seems to have furnished more current than the people were ready to make use of at the old figures, and sharp competition between the companies resulted. Since Jan. 1 there has been a quiet contest for business at cut rates, and this broke out into open warfare on April 12. Assertions are made that one or more of the companies is trying to bring about a combination, though each of the companies denies this. It appears that there is a prospect for a continued fight for supremacy, in which case the question of the cheapness of electricity generated by water power and that generated by steam power may be solved by a practical process, so far as the Pacific Coast is concerned. The price of fuel in this section is so high that the companies operating their machinery by water power claim a large advantage over their competitors.

CANADIAN NOTES.

NEW YORKERS TO CONTROL CANADIAN STREET RAILWAYS.—The deal by which a New York syndicate is to obtain control of the electric street railway in the city of Hamilton, Ont., and is to build the projected electric railways to Caledonia and Guelph, is said to be nearing consummation. It has been given out that the syndicate has obtained control of shares amounting to $103,000, the total stock being $205,000. Negotiations are not quite concluded.

STEALING ELECTRICITY is one of the most modern offences against the law and the Lachine Rapids Hydraulic & Land Company, of Montreal, has recently made a discovery which leads it to believe that this form of thievery is carried on to a greater extent than the company imagined. In one particular instance it was discovered that a saloon keeper who paid for about five lights, had some twenty-five more put into his place, and by means of connections unknown to the company obtained the necessary amount of current.

IMPROVING OTTAWA'S RAILWAY PLANT.—The Ottawa Street Railway Company is installing an improved plant in its power house, which, with one-half the water power formerly used, it is calculated will supply power for the operation of all the cars in present use in the city. The dynamo,

which will shortly arrive, will be a 1-600-hp machine. Hitherto the company has had no reserve machinery, and in case of a breakdown everything was thrown into confusion. By the installation of the new apparatus, provision is made for this contingency, but the inauguration of Sunday service has rendered it necessary for such increase in the efficiency of the power plant.

General News.

THE TELEGRAPH AND TELEPHONE.

FREMONT, OHIO.—The Fremont Home Telephone Company has been organized with a capital stock of $60,000.

EDGARTON, MO.—The Platte-Purchase Telephone Company has been incorporated at Edgarton, Mo., with a capital stock of $15,000.

PIEDMONT, VA.—The Gordon Telephone Company of this city has purchased the lines of the Maryland & West Virginia Telephone Company.

PHOENIX, ARIZ.—A 50-year telephone franchise has been granted to L. H. Chalmers on condition that he furnish the city with eight free telephones.

BALDWIN, KAN.—The Kansas & Missouri Telephone Company is extending its line from this place to meet the main line at Wellsville, eight miles east.

LANCASTER, OHIO.—The City Council has refused to give permission to the North Electric Company of Cleveland, and the Plain City Company to establish a telephone system here.

TAUNTON, MASS.—The Taunton Telephone Company has been organized here with a capital stock of $50,000. The incorporators are Peter H. Con, Clinton Sproat and H. H. Shumway.

WHITE PIGEON, MICH.—A new telephone line is to be constructed between this place and Centreville by the independent people. An exchange will be established at each place.

WASHINGTON, PA.—The stockholders of the West Penn Telephone Company will hold a meeting on April 22 to consider the advisability of issuing preferred stock to an amount not exceeding $5000.

LITTLE INDIA, ILL.—With a capital stock of $600, the Virginia & Little India Telephone Company has been organized under the laws of New Jersey by Marquis L. Crum, Frank R. Virgin, and L. L. Fox.

BRISTOL, TENN.—The Pulaski Telephone Company, Pulaski, Va., intends to extend its lines east and west to Roanoke and Bristol, including the intermediate towns along the line of the Norfolk & Western Railway.

PLYMOUTH, PA.—The Plymouth Borough Council has granted a franchise to the People's Telephone Company on condition that if it join a trust or combination or otherwise lose its identity the franchise will be withdrawn.

CHILLICOTHE, OHIO.—The Chillicothe & McArthur Telephone Company has been incorporated to construct lines in Vinton, Ross, Jackson and other counties in this State. The incorporators are Lewis S. Dane, Dennis Steel and others.

LITTLE ROCK, ARK.—The Batesville & Winnerva Telephone Company has been incorporated with a capital stock of $25,000, and the officers are E. C. Cook, Sr., president; John A. Cokrum, vice-president; E. A. Farris, secretary and treasurer.

BALTIMORE, MD.—The Rowland Multiplex Telegraph Company has been organized in this city with a capital stock of $5,000000, by Messrs. John Gill, Alexander Brown, C. D. Fisher, Bernard N. Baker, Eugene Levering, Iva Remsen, F. H. Hamilton, all of Baltimore.

PLATTSBURG, N. Y.—Mr. George P. Lynch has petitioned for a franchise to establish a telephone system in this place, under the name of the People's Telephone Company of Plattsburg. The petitioner agrees to limit the yearly charge to $20 for business instruments and $15 for residences.

NEW PAYNESVILLE, MINN.—Steps are being taken for the organization of the Western Sterns Telephone Company for the purpose of building and operating a telephone line between this place and a number of villages hereabouts. Dr. P. C. Pilon, of this town, is at the head of the enterprise.

HAMBURG, N. Y.—The Hamburg Telephone Company has been organized to conduct a telephone line between Hamburg, Buffalo and various towns in Erie County. The capital stock is $10,000 and the directors are Jacob Peffer, John Schoepflin, William Kronenberg, N. C. Fish, H. D. Pierce, John A. Koepfer, and Fayette Kelly.

PEOPLE'S TELEPHONE COMPANY of New Orleans, which has the Ahern Detroit system, is offering $200,000 twenty-year first mortgage 6 per cent. gold bonds maturing 1918, being part of $300,000. It is based on an exchange with 3,000 instruments, yielding $130,000 a year with expenses of $55,000. The bankers are Holmes, Holmes & Beaton, Detroit, and Mudge & Brown, New York.

BALTIMORE, MD.—The Baltimore, Annapolis & Drum Point Telephone Company has completed its line to a point twelve miles from the proposed termini of the line at Patuxent, Solomon's and Drum Point. The length of the line will be 18 miles, and it will put Baltimore in direct communication with Southern Maryland. The line is already operating from Annapolis south to Prince Frederick.

WEST SUPERIOR, WIS.—The New Telephone Company has been granted a twenty-five-year franchise by the city council, subject to certain protective restrictions for the benefit of the city. The new company is now prepared to proceed with the work of establishing exchanges in Duluth and Superior. The Duluth Company has been incorporated under the laws of Wisconsin under the name of the Zenith City Telephone Company, and the Superior Company will be organized shortly.

GALENA, KAN.—The Galena Telephone Company has a franchise to build an exchange in Columbus, Kan., and as soon as the material arrives will commence work on the plant, which will be built to accommodate 100 subscribers, all complete, with metallic circuits. The above named company has a toll line from Galena, Kan., to Weir City, Kan., through Columbus, almost completed, and will extend the same to connect with Ft. Scott by way of Girard. The lines of this company connect over 1500 telephones.

BUTLER, OHIO.—The Ohio Telephone Construction Company, of Butler, Richland County, has been incorporated with $10,000 capital stock. The company is authorized to construct and operate telephone lines and exchanges to the following points: Sandusky, Norwalk, Wooster, Mansfield, Marion, Mt. Vernon, Lancaster, Chillicothe, Portsmouth, Elyria, Ashland, Millersburg, Bucyrus, Mt. Gilead, Newark, Circleville and Waverly, the two terminal points being Sandusky and Portsmouth. The incorporators are J. H. Neer, W. J. McCollough, L. F. Neer, A. Lanehart and W. L. Hissong.

FORT WAYNE, IND.—The negotiations entered into a few weeks ago between the United States Telephone Company, of Ohio, and the National Telephone and Telegraph Company of this city, were completed at a recent meeting held in this city. By the agreement the entire system of the Ohio company is opened to the patrons of the National company. The connection with the Michigan lines has been completed at Sturgis and within sixty days a junction will be formed in the new exchange now building at Anderson with the lines of the new long-distance company at Indianapolis, thus making the lines of the National company the connecting line for all the independent telephone users in Indiana, Michigan and Ohio.

PEORIA, ILL.—The Perry Automatic Telephone Company of St. Louis, which six months ago received a franchise to construct and operate a system of automatic telephones in this city, is now being perfected in its organization. The capital stock of the new concern will be $100,000, and it is expected that the plant will be in operation in about six months. The company that will operate in this city will be known as the Peoria Automatic Telephone Exchange, and will rent its telephones from the Perry Automatic Telephone Company. The rates to be charged under the new system will be $36 a year for business telephones, and $24 a year for residence instruments, all telephones being of the long-distance type. The main feature of the new system is that it does away with the necessity of maintaining a central exchange and a force of operators, all of the connections being made automatically.

FORT WAYNE, IND.—At the recent annual meeting of the Fort Wayne Telephone Company, which controls long distance wires all over Northern Indiana, Ohio and Southern Michigan, the following officers were elected: President, George W. Beers, of Fort Wayne; vice-president, C. H. Cory, of Lima, Ohio; secretary, D. J. Cable, of Lima, Ohio; treasurer, W. H. Duffield, of Lima. Directors, C. H. Cory, D. J. Cable, W. H. Duffield, W. L. Parmenter, F. W. Holmes, of Lima, and G. W. Beers, Henry C. Paul and Samuel M. Foster, of Fort Wayne. The president's report showed that the mileage of the lines had been increased twenty per cent. during the year. The number of telephones in use at exchanges is fifteen per cent. greater, the number of towns or toll stations connected with the system is forty per cent. greater, and the net earnings of the company exceed those of last year by a little more than 100 per cent.

ELECTRIC LIGHT AND POWER.

COLUMBUS, WIS.—A vote on the electric light question resulted in favor of municipal ownership. Bonds for $10,000 will be issued.

WHITE PLAINS, N. Y.—The Larchmont Electric Light Company has certified to an increase in its capital stock from $15,000 to $100,000.

CAMBRIDGE, OHIO.—The Guernsey Electric Company is the name of a new concern organized in this city, with a capital stock of $5000.

THE ALBANY WATER & ELECTRIC LIGHT COMPANY, of Albany, Ind., has filed articles of association with the Secretary of State; capital, $15,000.

MILWAUKEE, WIS.—The Assembly has passed the Senate bill which provides for an appropriation of $55,000 for an electric light plant for the university buildings and the capitol.

PHILADELPHIA, PA.—The Electric Company of America has secured an electric lighting and power plant on Long Island about ten miles from Jamaica. The company already owns a plant in Jamaica.

NEW PHILADELPHIA, OHIO.—The Goshen Electric Company has been organized here with a capital stock of $5000, by Augustus Boyer, Adam Lieser, William H. Lieser, Augustus A. Lieser and George W. Wilson.

COLUMBUS, OHIO.—The directors of the Columbus Electric Light Company have decided to install a new alternating system for incandenscent lighting. A new building will be erected on the present river site.

FAIRPORT, N. Y.—The people of this place are discussing the question of electric lighting on the plan of village ownership of the plant. It is the idea to operate the electric light plant in conjunction with the waterworks system.

SAG HARBOR, L. I., N. Y.—The Sag Harbor Electric Light & Power Company has been organized in this place with a capital stock of $25,000, by Robert K. Story, Charles Z. Southard and Samuel S. Watson, all of Brooklyn.

LEBANON, PA.—The police committee is advertising for proposals for the furnishing of electric light for this city beginning June 1 next. The proposals will be opened on May 15. The lights, open or enclosed arcs, must burn all night.

WATERTOWN, N. Y.—The Seneca Edison Company of Watertown has been formed to manufacture electricity; capital, $50,000. Directors, S. Dana Greene, Schenectady; Norman H. Beeker, Seneca Falls, and H. M. Francis, Brooklyn.

JERSEY CITY, N. J.—The Guttenberg Council has granted a franchise to the North River Heat, Light & Power Company to erect poles and string wires. The franchise is an unlimited one and calls for no compensation from the company.

PASSAIC, N. J.—The Hackensack Electric Light & Power Company has secured control of the Ridgewood Electric Light Company, and it is said to be the intention to eventually light the latter place from the Hackensack station and close up the plant at Ridgewood.

BANGOR, ME.—Plans are under way for the installation of a new electric light plant at the waterworks at a cost of between $25,000 and $30,000. It is the intention to put in another water wheel and an entirely new electric plant which will be capable of giving sufficient light for the streets for some years to come. It is proposed to issue bonds to provide for these improvements.

THE ELECTRIC RAILWAY.

DELHI, OHIO.—The councils at Delhi and Cleves have granted 25-year franchises to the Cincinnati & Aurora Electric Railway Company.

OSWEGO, N. Y.—The Oswego Electric Street Railway Company has been sold under mortgage foreclosure for $80,000, to Mr. Max B. Richardson, who represented the bondholders.

NEW YORK, N. Y.—The Brooklyn Elevated Railway Company has inaugurated an open car service on its road. Over 100 open cars will be placed in operation during the summer.

LEWISTON, PA.—The Kishacoquillas Turnpike Company has sold to the Lewiston & Reedsville Electric Street Railway Company, six miles of macadamized turnpike at Lewiston for $28,000.

ATTLEBORO, MASS.—The Attleboro & Norton Electric Railway, the Norton & Taunton Railway, the Mansfield & Norton and the Eastern & Mansfield Electric Railway Companies have been consolidated.

NEW YORK, N. Y.—The Union Railway Company which is controlled by the Third Avenue Railway Company, is planning to extend its 161st Street line to connect with the Manhattan elevated railway.

LAWRENCE, MASS.—The Lowell, Lawrence & Haverhill Street Railway has been purchased by a New York syndicate. The deal involves the transfer of the greater part of $3,000,000 worth of stocks and bonds.

DALLAS, TEXAS.—One of the boilers in the station of the Standard Electric Light & Power Company in this city exploded on the night of April 9, causing damage to the property to the amount of $30,000 or $40,000.

KENOSHA, WIS.—The City Council has passed an ordinance granting to the Milwaukee, Racine & Kenosha Electric Railway Company a franchise to build, maintain and operate a street railway over the streets of the city.

JACKSON, MICH.—The organization of the Adrian & Jackson Traction Company has been completed. Mr. H. C. Smith has been elected president. The company will build an electric railway line to connect Adrian and Jackson.

XENIA, OHIO.—The Xenia & Wilmington Traction Company has been formed for the purpose of building an electric railroad from Xenia and Wilmington to Paintersville, Port Clinton, etc. The incorporators are: Albert Emanuel, Frank S. Brown, Samuel A. Price, all of Xenia; Henry B. Pruden, Harry A. Armstrong, of Wilmington. Capital stock, $10,000.

KANSAS CITY, MO.—The Kansas City & Leavenworth Railway Company, with a capital stock of $1,000,000 has been chartered under the Kansas laws to build an electric railway from Kansas City, Kan., to Leavenworth, Kan., a distance of 26 miles. The line which was projected by Mr. W. E. Winner, of this city, has secured the financial backing of Cleveland, Ohio, capitalists.

SOUTH NORWALK, CONN.—It is reported that the Norwalk street railway has been sold to a syndicate composed of Messrs. W. F. Sheehan, R. A. C. Smith, H. G. Runkle, A. M. Young and others. These gentlemen already control the lighting interests of Norwalk. The price paid for the railway is said to have been between $65 and $80 per share, the par value of which is $25.

SCARSDALE, N. Y.—The Highway Commissioners have granted a franchise to the Tarrytown, White Plains & Mamaroneck Street Railway Company to extend its line from White Plains through Scarsdale to Mt. Vernon. The road which will run from the Hudson River to Long Island Sound will be built by the Union Railway Company which now operates all the trolley lines in the Borough of the Bronx.

RICHMOND, VA.—It is given out on good authority that a syndicate has been formed, to purchase the property, franchise, etc., of the Richmond Railway & Electric Company. Negotiations have practically reached a final settlement. The Richmond Railway & Electric Company is itself a collection of several small companies, and it is generally believed that this purchase is a step towards the early consolidation of all the electrical interests in the city.

NORWICH-NEW LONDON TROLLEY.—The Superior Court of New London County, Connecticut, has decided in favor of the public necessity and convenience of the Norwich and New London trolley parallel. The Vermont Central Company making no opposition, work on the parallel will begin next week, and it will probably be opened next autumn with a power house at Montville. The contest in the courts and legislature has lasted for several years.

CINCINNATI ROAD AGAINST COMBINATION.—The Enquirer says: "An agent of the combine of street car builders of the United States has been in this city trying to secure the co-operation of the Consolidated Street Railroad Company, which controls all the roads in the city under a fifty-year franchise. He failed completely. On the contrary, he was told that the Cincinnati company would immeditely enlarge its car plant, make all its own cars, and keep out of the combine."

GAINESVILLE, GA.—Mr. D. E. Evans, of this city, is forming a new company for the purpose of rebuilding the old street car line. He has bought a fine water power on the river three and one-half miles from town and expects to build a stone dam 300 feet long by 20 feet high. Water wheels and dynamos will be installed at the plant. The railway will be five miles in length and will be equipped with the latest and best equipment. The new company will furnish power for factories, and lights for the streets and houses.

ATLANTA, GA.—It is stated that the organization of a $2,000,000 syndicate for the purpose of consolidating and operating the three trolley systems of Atlanta is pending. The street railways involved are the Atlanta Consolidated Street Railway Company, the Atlanta Street Railway Company and the Atlanta Electric Company. If the contemplated deal is carried through all of these companies will be owned and operated by one management. It is reported that one million dollars has been subscribed in this city toward the new syndicate and that the other million dollars will be furnished by Baltimore capitalists.

PEEKSKILL, N. Y.—The Peekskill Traction Company has organized by the election of Frank Frye, president; Charles Mason, vice-president; J. L. Jarvis, treasurer, and Jacob Lorsch, secretary. Its directors are Matthew Clune, J. F. Martin, James H. Haight, Hanford Smith, and J. R. Decatur, and the above officers. They intend to begin the work of building the road at once. It will connect the Hudson River Railroad station with the State Camp of Instruction, Lake Mohegan, and Verplanck's Point. The company expects to have the road running by Decoration Day.

LANCASTER, PA.—The work of forming the People's Electric Railway Company has proceeded to a point where a charter will be applied for at once. The following named gentlemen are the incorporators of the company: John H. Myers, A. B. Landis, Joseph U. Fritchey, E. H. Hershey, John J. Patterson, Milton T. Eby, E. T. Fraim, John Hiemez and Dr. Henry Yeagley. It is the intention of the company not only to operate a system in this city, but suburban lines as well, to Mannheim, Ephrata, New Holland and Adamstown, where connections will be made with the road running to Reading and other places

BALTIMORE, MD.—A deal for the purchase of the Nashville Street Railway Company and the electric light plants of Nashville, Tenn., has been practically consummated, and negotiations are pending for the acquisition of the other street railway properties of the gas company. The Baltimore Trust & Guaranty Company which is financing the deal is now completing the details of the transaction. It is stated that the new company will issue about $3,500,000 of 5 per cent. bonds, though the total mortgage will be for $6,000,000. Bonds to the amount of $2,500,000 will be retained in the treasury to retire underlying liens of the companies absorbed as they mature.

BRESLAU, GERMANY.—The city of Breslau is about to grant a charter to the street railroad company for a term of twenty-four years, with privilege of putting the same under electric motive power in place of horse power, which is used at present. The reconstruction of the roads must be completed within two years after the contract has been approved. Overhead and underground systems are to be used. The company agrees to take from the city what electric motive and lighting power it may use for the cars; the city binds itself to furnish sufficient power for said purpose, but is not liable for any damages in case of a breakdown at the power house. The fare is to be 10 pfennigs (2.38 cents), with transfer over any of the lines.

PITTSBURG, PA.—It is understood that the scheme of the Monongahela Traction Company to control the electric lighting franchises of all important towns outside and to the east of Pittsburg in Allegheny County, and to operate the lighting plants in connection with the railway line, has been practically consummated. Application will be made during the present month by Messrs. Mellon Brothers, bankers, owners of the Monongahela Traction Company, for a state charter for the Monongahela Light & Power Company. Options on all of the plants in the territory to be covered are said to have been secured and the consummation of the plans of the company simply awaits the granting of a charter. The capital stock will probably be $10,000,000.

A RECEIVER FOR THE EVANSVILLE STREET RAILWAY COMPANY.—Mr. H. D. Moran was on April 14 appointed receiver for the Evansville (Ind.) Street Railway Company by Judge Mattison, of the Circuit Court. The application was made by John E. Bowless, a creditor, of New York, who secured a judgment against the corporation for $26,782.54. The company has a bonded indebtedness of $1,000,000, which is secured by mortgage. A large sum is due the city for street improvements and it is alleged that the company is indebted to its employes in a large sum. The stock is owned by Boston and New York investors, while the franchise and property belong to Cleveland capitalists. The receiver will operate the road until further orders from the court.

LEGAL NOTES.

THE BROOKLYN CITY RAILWAY LEASE.—The Court of Appeals at Albany on April 18 affirmed the judgment of the courts below in the suit brought by Patrick H. Flynn against the Brooklyn City Railway Company and the Brooklyn Heights Railway Company to set aside the lease made by the former of its lines to the Brooklyn City Railway Company. The decision sustains the validity of the lease, the court below having thrown out Mr. Flynn's complaint. Mr. Flynn was a minority stockholder in the Brooklyn City Railway and alleged that his interests had been injured by the lease of the road. He therefore brought suit to compel the re-transfer of all the property that passed under the lease and an accounting by the lessee to the lessor of the renting of the property and the payment of the Brooklyn City earnings to the lessor by the lessee.

THE DOVER ELECTRIC COMPANY.—Vice-Chancellor Pitney rendered a decision recently at Chancery Chambers, Jersey City, in favor of the directors of the Dover Electric Company, Dover, N. J., declaring the issue of 129 shares of stock legal. The litigation was for the control of the company. Leopold I. Schwartz, who was treasurer of the company, purchased a majority of the stock that had been issued and began negotiating with the syndicate that was purchasing or leasing established companies. The directors met, and, finding that all the capital stock had not been issued, the 129 shares were ordered issued, and were sold to William C. Whittingham, of Newark, who conveyed them to the directors, and they secured a majority. Treasurer Schwartz refused to sign the certificate of stock, and was deposed. Then he appealed to the Court of Chancery and was defeated.

EDUCATIONAL NOTES.

THE ROSE POLYTECHNIC INSTITUTE, Terre Haute, Ind., has issued its 17th annual catalogue with an outline of the courses of study and the plan of instruction. The course of instruction at this Institute includes mechanical, electrical and civil engineering, architecture and chemistry. The general plan of instruction is based upon the fundamental principle that laboratory and shop work, field and office practice, constitute one of the most important elements in a sound education. This plan has been steadily adhered to by this institution during the sixteen years of its existence.

PURDUE UNIVERSITY, Lafayette, Ind., has issued its annual catalogue for 1898-99, with announcement for 1899-1900. The purpose of this institution is to afford the young men and women of Indiana the opportunity to acquire a good education in mathematics, science, literature and art, and at the same time secure instruction and practice in such lines of work as will fit them to engage in the practical industries. The instruction is both theoretical and practical. The university has also issued special pamphlets containing the announcement of courses in railway engineering and railway management and in the school of applied science.

THE AMERICAN SCHOOL OF CORRESPONDENCE.—The handbook of this institution, which is doing excellent work in correspondence teaching, gives a great deal of information concerning its methods of instruction. This institution is chartered by the Commonwealth of Massachusetts and is a technical school for mechanics, giving exclusive attention to steam and electrical engineering and the construction and operation of machinery. An outline of the studies in the different courses is given, and judging from the samples of the question papers and instruction papers at hand, it is evident that the work carried on is high class.

PERSONAL NOTES.

MR. L. B. STILLWELL, electrical director of the Niagara Falls Power Company, has returned from a trip abroad.

MR. WEARE PARSONS, of Chicago, has been recently appointed Superintendent of the Southwest Electric Light & Power Company at Joplin, Mo.

MR. J. P. ORD, vice-president and comptroller of the General Electric Company, left this week for a couple of months' recreation in Europe, immediately after the issuance of the annual report.

MR. W. W. BORMAN, an associate of Mr. Robert W. Blackwell, in England, is visiting this country to meet the correspondents of the firm and to make some important new connections in its behalf. He may stay over on this side for some time.

MR. A. B. CHANDLER, president of the Postal Telegraph and Sprague Electric Companies, is, we are glad to note, convalescent after a severe spell of sickness which confined him to his house for a couple of weeks. He has gone South for a change.

PROF. R. B. OWENS, a graduate of Columbia University, New York, and now of McGill University, Montreal, has been awarded by the Columbia University Council the Tyndall fellowship. It is understood that he will go to England this year to carry out some original work.

MR. HERMAN A. STRAUSS has resigned as General Manager of The Electrical Engineer Institute of Correspondence Instruction. In accepting his resignation, the Institute has expressed its regret at losing the valuable services of Mr. Strauss and wishes for his success in his future undertakings.

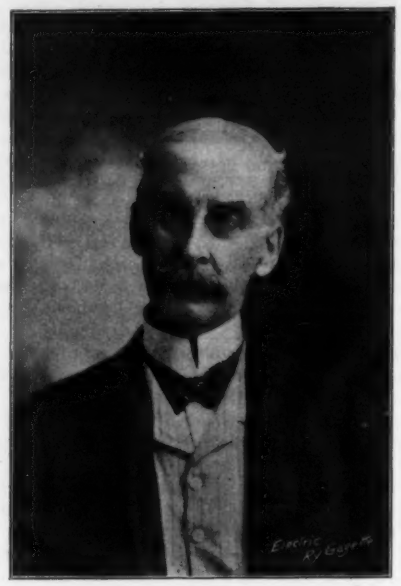
MR. A. LANGSTAFF JOHNSTON, civil and electrical engineer, has returned recently from a trip made for professional purposes to the Republic of Honduras. He found there a country offering many opportunities for American capital and enterprise. He mentions the fact that for a new electrical plant in one of the cities the apparatus comes from Switzerland.

MR. JEFFERSON WETZLER, so well and favorably known as New York representative of The Electrical Engineer, has become connected now with its prosperous Institute of Correspondence Instruction as its secretary and treasurer. He is devoting his energies with great success to carrying its work into new fields, and reports a brilliant outlook.

MR. W. R. McLAUGHLIN, late of *The Electrical World*, has accepted a position with Dick Brothers & Co., bankers, of 30 Wall street, New York, which firm he will represent in the placing of investment securities. A member for nine years of *The Electrical World* staff, Mr. McLaughlin has a wide acquaintance in the electrical field, and we feel that we join with hosts of warm friends among these in wishing him the fullest measure of success in his new work.

MR. WILBUR F. HANKS, formerly of The Electrical Engineer, has become associated with the E. L. Powers Company, Incorporated, as business manager. This company, whose headquarters are at 150 Nassau street, New York, is publisher of the American Street Railway Directory, and the American Electrical Directory. Messrs. Hanks and Powers are well known in the electrical trades and under their management these publications should meet with success.

MR. D. G. HAMILTON, who has just been elected by the directors of the Chicago City Railway Company to fill the position of president, which position was made vacant by the recent death of Mr. M. K. Bowen, was born in Chicago in 1842, in which city he received his education and has spent most of his life. Mr. Hamilton is a lawyer by profession, but has been identified with street railway interests for so many years that he is perhaps more widely known as a street railway manager. He has always resided in Chicago and made that city his headquarters for the various business interests under his management. Mr. Hamilton became interested in the Chicago City Railway fifteen years ago, when that property was insignificant compared with what it is now, and he is thoroughly familiar with the company's affairs and policy and has a large financial interest in it. These considerations led the directors to select him as the only member of the board who was particularly fitted to fill the office of president, and, although Mr. Hamilton's large personal interests demand much of his attention, he consented to accept the position. Ten years ago Mr. Hamilton, with other Chicago gentlemen, formed the National Railway Company of St. Louis, Mo., which proved to be one of the largest factors in the development of street railway transportation in that city. Mr. Hamilton was at the head of the company until the close of January, this year,



D. G. HAMILTON.

when he resigned. At the time of his election as president of the Chicago City Railway, Mr. Hamilton occupied the position of second vice-president of the same company. His familiarity with the affairs of the company makes his services valuable for the new position.

OBITUARY NOTE.

FRANKLIN SHEBLE.—It is with extreme regret that we note the sudden death from appendicitis on Thursday, April 21, in Philadelphia, of Mr. Franklin Sheble, a young electrical engineer of great ability and high character. He was born in Philadelphia on April 10, 1866, and educated at the Central High School, University of Pennsylvania, Mechanical Engineering Department and Cornell University, Electrical Engineering Department, and had studied the science with great closeness and enthusiasm. He graduated bachelor of science in the Mechanical Engneering Department, University of Pennsylvania, in 1887, his thesis being printed in the Journal of the Franklin Institute, and he graduated as M. E. in 1888, and as Master of Science (with distinction), in 1889, at Cornell. On entering the field of practical work, he joined the staff of the General Electric Company, spending five and one-half years at Lynn and Schenectady, having charge at one time of the meter department and of railway testing. He was engaged later on general railway engineering and inspection work, and later in installing 1500-kw generators for the People's Traction Company, and other large ones for the Philadelphia Electric Traction Company. In November, 1894, he organized the firm of Sheble & Patton, Ltd., as electrical engineers and manufacturers. For some time past he had been connected with the New York office of the Stanley Electric Manufacturing Co., as its engineer, etc., associated with Mr. M. D. Barr. He was a member of the American Institute of Electrical Engineers. The loss of this amiable and talented young man comes as a severe blow to a host of friends, who sympathize deeply with his wife and family in their bereavement.

Trade and Industrial Notes.

THE ATLANTIC ELECTRIC VEHICLE COMPANY has been incorporated in New Jersey with a capital stock of $100,000.

MESSRS, McCARTHY & FORD, of Buffalo, have been awarded the contract by the Buffalo Fire Department for furnishing 1500 cells of storage battery, for $2,750.

THE UTICA FIRE ALARM TELEGRAPH COMPANY, Utica, N. Y., has been awarded a contract by the Buffalo Fire Department for a new 64-circuit switchboard for $6,700.

THE L. WOLFF MANUFACTURING COMPANY, Chicago, has recently placed in operation a 150-hp engine, built by the Ball Engine Company, Erie, Pa., direct connected to a Western Electric generator.

MR. JAMES WOLFF, Western representative of the New York Insulated Wire Company, will attend the convention of the National Electric Light Association and the Electrical Exhibition, which will be held in New York in May.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., has issued a four-page circular describing its inductor generators, which type of machine was described and illustrated in *The Electrical World and Electrical Engineer* of March 25, 1899.

MR. W. H. EDGAR, President of the Dearborn Drug & Chemical Company, Chicago, is on a trip to the Pacific coast and Japan. A very marked improvement in this company's business is reported in comparison with the first three months of last year.

MESSRS. POTTER & BENSON, Monadnock Building, Chicago, have received an order from the Garner Electric Light, Power & Telephone Co., of Garner, Ill., to act as purchasing agents and to superintend the construction of its new telephone plant.

THE SIPP ELECTRIC & MACHINE COMPANY has been organized in Paterson, N. J., to manufacture electrical machinery. The capital stock of the company is $50,000, and the incorporators are Grant Sipp, Arthur Goldthorp and Henry Cooper, all of Paterson, N. J.

MR. A. LOUIS KUEHMSTED, general manager of the Charles E. Gregory Company, Chicago, reports that his company's business has increased to such an extent that it was necessary recently to lease the building, Nos. 54-56 South Clinton Street, which adjoins its present quarters.

NATIONAL ASSOCIATION OF MANUFACTURERS has just issued in handsome form its report of the fourth annual convention held at Cincinnati with so much success in January. It makes a quarto of 106 pages, full of interesting data and information. The next meeting is to be held in Boston.

STORAGE BATTERIES IN ISOLATED PLANTS.—Circular No. 49, of the Electric Storage Battery Company, Philadelphia, just issued, is devoted to a description (with illustrations) of the installation of chloride accumulators in the Hartford Battery Station of the New York, New Haven & Hartford Railway.

MR. J. C. FISH, of the Shelby Incandescent Lamp Company, Shelby, O., reports a decided increase in business in his section of the country. He states that the company is doing the largest lamp business in its history, and that it is now its intention to again increase its producing capacity for the coming fall business.

AMERICAN ELECTRICAL SUPPLIES IN ENGLAND.—In a note in our issue of April 22, it is stated that Mr. Irving P. Favor, 123 West Houston Street, New York, is endeavoring to secure the English agency for high grade American electrical specialties. This is an error, the name of Mr. Favor having in some manner been substituted for that of another person.

SPANISH-AMERICAN WAR PANORAMA.—The "Big Four Route" has issued an album containing 160 half-tone engravings illustrating incidents, notable persons, people and places in connection with the Spanish-American war. A copy may be obtained by sending 12 cents (to cover postage and packing) to Mr. E. O. McCormick, Passenger Traffic Manager, Cincinnati, Ohio.

THE JOHN T. NOYE MANUFACTURING COMPANY.—Receiver Edwin P. Sears, of the John T. Noye Manufacturing Company, Buffalo, N. Y., is keeping the plant in active operation, pending a reorganization of the company. All orders and contracts will be promptly and satisfactorily executed. The statement in these columns that the affairs of the company were being closed up was erroneous.

CABLE TESTING SETS.—Mr. James G. Biddle, 1038 Drexel Building, Philadelphia, has recently furnished cable testing sets supplied with the new Willyoung d'Arsonval galvanometer to the Pennsylvania Telephone Company, the New York Telephone Company, Delaware & Atlantic Telegraph & Telephone Company, Standard Electric Company of California, U. S. Signal Corps, Safety Insulated Wire & Cable Company, and others.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has taken the contract for the new roof on the East Armory of the Colt's Fire Arms Manufacturing Company at Hartford. This roof is 60 feet wide and 500 feet long, and is to be entirely recovered. The new roofing is to be the Berlin Iron Bridge Company's patent anti-condensation fireproof roof lining consisting of anti-condensation lining underneath the corrugated iron outside covering.

THE TIE PLATE PLASTIC RAIL BOND.—Mr. Harold P. Brown, 120 Liberty street, New York, has issued a unique circular illustrating the tie plate plastic rail bond. The sheet is folded in such a manner that by opening the three flaps successively a different view is presented to the eye, the idea being to illustrate the parts of the bond and the method of applying them to rails. The different illustrations show the successive stages of the work of bonding rails.

THE WESTERN ELECTRIC COMPANY in manufacturing its fan motors not only has the armatures perfectly balanced, but also weighs the fan blades and inspects and balances the fans independently of the motors before assembling. This careful attention to details is one of the features which makes the Western Electric fan motors so efficient. The forty-page fan motor catalogue describing the various makes of fans should be in the hands of those who are interested.

CARBON COMPANY RAISES WAGES.—The National Carbon Company has raised the wages of about 400 men employed in its West Madison Avenue plant in Cleveland, Ohio. The advance ranges from 5 to 15 per cent. Prior to the announcement of the increase a strike was threatened. Some of the men are satisfied with the new scale and some are not. It is estimated that about fifty men dissatisfied with the new rate left the company's employ upon the posting of the same.

THE NATIONAL INDIA RUBBER COMPANY of Bristol, R. I., has just issued a neat catalogue of its rubber-covered wires and cables for electric light, power and telephone service. These wires and cables are made solid, stranded and flexible, and in their manufacture high-class special conductors are used. In addition to information regarding these products, the pamphlet contains several tables which will be of great assistance to engineers in the work of wire calculations.

THE MARSHALL & HUSCHART MACHINERY COMPANY, Cleveland, O., selling agents for Gould & Eberhardt, of Newark, N. J., has sold to the Brown Hoisting & Conveying Machine Company, Cleveland, an automatic gear cutting machine of 120 x 20-in. capacity. This machine is a duplicate of one built by Gould & Eberhardt and recently installed at the works of the Blake steam pump plant at East Cambridge, Mass. It is said to be the largest size of entirely automatic gear cutting machines built.

GARTON LIGHTNING ARRESTERS.—The seaon for thunderstorms is at hand and the Electric Appliance Company, of Chicago, is reminding the station manager that it is high time to look for lightning protection. It has prepared a complete catalogue of Garton lightning arresters, a copy of which it will be glad to send on application. The Garton lightning arresters have a long record of unbroken success and are among the best known lightning protectors on the market at the present time.

FACTS ABOUT CUBA.—Those having present or prospective business relations with Cuba will be interested to know that the National Railway Publication Company of 24 Park Place, New York, has just issued a leaflet containing a map, time tables and lists of officers of railways and steamship lines in Cuba. It also contains some interesting and practical information for business men regarding the methods of conducting business on the Cuban railways, and other information of a kindred nature.

THE GARTON DANIELS ELECTRIC COMPANY, Keokuk, Ia., has issued two small printed slips calling attention to the valuable features of the Garton lightning arresters. The most impressive facts are found in a list of recent orders for lightning arresters. The Laclede Power Company, St. Louis, sends its seventh order; the Chattanooga Electric Railway Company its sixth order. Six other companies their fourth and three their third. Three-tenths of one per cent. of all the electrical repairs to car equipments on the Chicago City Railway during 1898, were repairs on lightning arresters—a good showing, indeed.

THE GOHEEN MANUFACTURING COMPANY, Canton, Ohio, has just issued a pamphlet containing half tone illustrations of structures, the iron work of which is protected by "Carbonizing Coating," manufactured by this company. The company reports that the demand for this material so far this year has surpassed that of all former years, and that as a consequence it has been necessary to enlarge its plant for the manufacture of this protective coating. "Carbonizing Coating" is a chemical combination of materials which, when applied to iron and steel, gives lasting protection to these metals. It is used by many of the leading engineers, architects and large consumers of paint.

THE GENERAL ELECTRIC COMPANY has issued, in its usual artistic style, its 1899 fan-motor catalogue. The 28 pages are handsomely illustrated with fan motors, of both the alternating and direct current types, and views of offices, dining rooms, etc., showing the wide field of application of these useful machines. With each illustration is given the specifications of the machine so represented. The constituent parts of the motors are also illustrated in an artistic manner. The illustrations are largely marginal, which arrangement gives a very pleasing effect. Bird's-eye views of the Lynn, Schenectady & Harrison works, together with a brief dissertation on fan motors in general, constitute an interesting introduction to the main contents of the catalogue, which is a product of the General Electric press.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., in a neat little pamphlet just issued, calls attention to the advantage of renewing burned-out incandescent lamps. It is stated that about $20,000 is thrown away every month in the United States in the shape of burned-out incandescent lamps. These burned-out lamps are worth three cents apiece, or $7.50 per barrel. This company will take these lamps, renew them and put them in as good condition as they were originally. They are tested as to efficiency, voltage and candle-power precisely the same as a new lamp. The company is making a new lamp that is said to be the most mechanically correct lamp made. The filament is anchored to the glass stem, and is rigidly held in place. This is claimed to be the only correct way to place a filament in a lamp.

THE ERICSSON TELEPHONE COMPANY will on or about May 1 move its headquarters to 296 Broadway, New York. It has just issued a neat little catalogue of Ericsson Swedish coal-grain microphones, and bi-polar, all metal, "never-changing" receivers. The catalogue is replete with illustrations and brief descriptions of the various styles of apparatus handled by this company. These instruments are well known to telephonists for their excellence in operation, durability and high class construction and finish. Some unique and useful outfits are shown in the catalogue. A portable testing set, designed for military purposes and in places where frequent shifting of the instrument is necessary, consists of two dry cells, combination microphone and receiver, generator, bell, lightning protector and terminals for lines and earth—all neatly encased in a small box.

ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has furnished a handsome new generator for practical work to Syracuse University. It is of 30-kw, and the tests by Drs. Hanael and Graham have given excellent results. The generator recently installed is a source of great pride to the University, and the efficiency test should be very gratifying to the manufacturers, the Onondaga Dynamo Company of Syracuse. It is pleasing to note the rapid strides made by this company in the last few years. They have recently installed a number of plants in their own city as well as in New England and the Middle Atlantic states. They are at present installing a large plant in the new Gridley Building at Syracuse, and another at Cortland, and are at present building in their works a large generator for one of the big summer hotels at Atlantic City. The latter is to be an extremely fine plant.

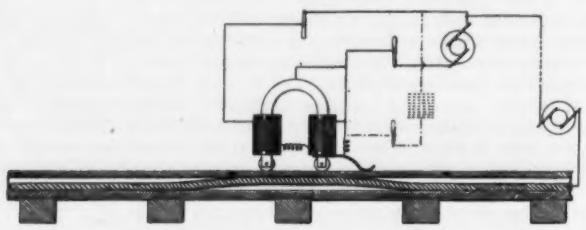
SPEED REGULATOR FOR SMALL MOTORS.—The Ward Leonard Electric Company, Bronxville, N. Y., is manufacturing a speed regulator suitable for motors from 1-16 to 1-hp inclusive. Its trade designation is the "T.R." type, and it can be furnished with resistance from 1600 to 12.5 ohms. In its construction the resistance is wound about a pottery tube, after which it is covered with two or more coats of especially prepared porcelain enamel, completely covering and hermetically sealing it. During the past six months the company has manufactured many thousands of these tubes, all of which, it is stated, have proven satisfactory. These resistance tubes are particularly well suited for use in small regulators, and special rheostats of high resistance and low ampere capacity. The company manufactures a complete line of resistance units in three different watt capacities, viz., 36 watts, 72 watts and 144 watts (continuous duty), there being 26 different graded resistances for each watt capacity.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 18, 1899.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

623,136. SAFETY CABLE SYSTEM FOR ELECTRIC RAILWAYS; H. B. Cox, New York, N. Y. App. filed Feb. 12, 1898. A magnetizable conducting cable is laid in a conduit of non-conducting material having a sectional cover of conducting material. The car carries a magnet which runs close



No. 623,136.—Safety Cable System for Electric Railways.

to the top of the conduit and lifts the conductor therein into electrical connection with the cover from which the current is taken by a brush

623,141. APPARATUS FOR STARTING ELECTRIC ELEVATORS; D. H. Darrin, Cranford, N. J. App. filed Aug. 1, 1898. The object is to prevent the settling of the car at the start, caused by failure of belts to shift immediately and take hold on the tight pulley when the load of the car is put upon the motor and the brake released. There is provided an auxiliary switch, controlling the motor circuit for starting, a device in the car for controlling the switch, the switch remaining normally open, and a main switch automatically opened and closed by the belt shifting mechanism simultaneously with the shifting of the belt and the brake.

623,142. ELECTRIC ELEVATOR SWITCH; D. H. Darrin, Cranford, N. J. App. filed Aug. 1, 1898. The switch is provided with successive contacts arranged to close the motor circuit in advance of the releasing of the brake and shifting of the belt, enabling the motor to start without load.

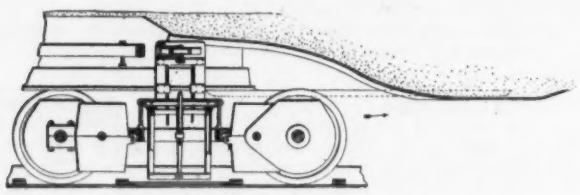
623,172. JUNCTION BOX; T. J. Murphy and R. J. Neilson, New York, N. Y. App. filed Dec. 9, 1898. The box is intended for use in buildings and is built in sections, certain portions that are not liable to injury during the construction of the building being first put up, and the ornamental portions being put into position when the building is finished; this prevents injury to the ornamental parts of the box.

623,180. INCANDESCENT BULB AND SHADE REMOVER; John J. Rhine, of Pittsburg, Pa. App. filed Dec. 27, 1897. (See Current News and Notes.)

623,195. ELECTRIC ACCUMULATOR; Alexis Werner, London, England App. filed July 12, 1898. (See Current News and Notes.)

623,215. AUTOMATIC STATION INDICATOR FOR RAILWAY CARS; A. Hunter and C. Gustafson, San Francisco, Cal. App. filed March 29, 1897. The indicator is driven by a motor in the main circuit, the invention consisting particularly in the details of construction and the provision of an automatic reversing switch located on the trolley and adapted, by the change in the working position of the trolley at the end of the run, to reverse the current on the indicator operating motor, and thereby change the direction of movement of the indicator.

623,223. ELECTRIC RAILWAY SYSTEM; Wilhelm Stein, of Hamburg, Germany. App. filed Oct. 3, 1898. (See Current News and Notes.)



No. 623,248.—Railway.

623,248. RAILWAY; T. J. King and A. O. Babendreier, Washington, D. C. App. filed Sept. 20, 1898. Where a conduit is used on one portion of the road and an overhead trolley on another, the inventor provides an inclined plane in the conduit against which the plough strikes and is raised out of the slot at the point where the conduit terminates and the overhead system begins. The plough is locked in its elevated position and automatically released when the car leaves the overhead system and enters the conduit system. The operations are accomplished automatically and while the car is in motion.

623,249. RAILWAY; T. J. King and A. O. Babendreier, Washington, D. C. App. filed Sept. 7, 1898. A simplification or improvement on the preceding patent.

623,250. RAILWAY; T. J. King and A. O. Babendreier, Washington, D. C. App. filed Oct. 11, 1898. Specific improvements on the preceding contemplating simplicity, durability, and reliability in the means for locking and unlocking the plough in its elevated position.

623,275. ELECTRIC LETTER FOR SIGNS; C. A. Chase, Chicago, Ill. App. filed April 18, 1898. The front board is provided with openings into which the sockets for the lamps project, the sockets being held in this position by the back board against which they rest.

623,279. ARC LAMP; Thomas E. Drohan, of Chicago, Ill. App. filed Aug. 8, 1898. (See Current News and Notes.)

623,293. ELECTRICALLY CONNECTED PRINTING MACHINE; C. A. Shea, Milton, Mass., and J. J. O'Lalor, Medford, Mass. App. filed April 20, 1896. The important feature of this printing telegraph system is that all the machines in the line, are automatically brought to unison after the printing of each letter. The operating parts of the machine start from the same position of rest as each key is depressed, and after the key is released the arms are brought to that point again.

623,316. INDUCTION APPARATUS; Thomas B. Kinraide, of Boston, Mass. App. filed May 5, 1898. (See Current News and Notes.)

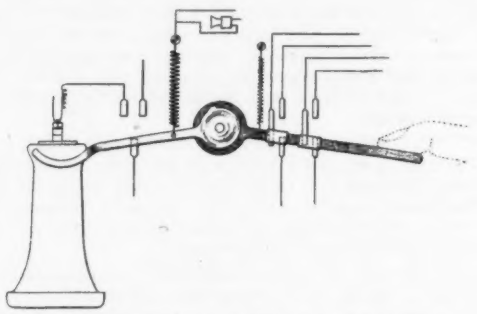
623,317. ELECTRICAL BRAKE; Thomas B. Kinraide, of Boston, Mass. App. filed May 5, 1898. (See Current News and Notes.)

623,318. ELECTRICAL SPARK GAP; Thomas B. Kinraide, of Boston, Mass. App. filed Sept. 24, 1898. (See Current News and Notes.)

623,329. ELECTRIC ARC LAMP; A. Mougin, Paris France. App. filed Oct. 21, 1898. The mechanism of this lamp is designed to operate with the carbons in any position, the invention consisting of the details of construction.

623,352. DUPLEX SWITCH FOR TELEPHONES; G. C. Buell, Boston, Mass. App. filed Aug. 15, 1898. Intended for use where an auxiliary instrument is found desirable on a subscriber's premises. The switch includes a member for supporting the receiver and performing the usual operations, and a second switching mechanism for transfering the main line connections from one instrument to another, operated by the first member, but capable, when desired, of being operated independently of it.

623,363. ELECTRIC LIGHT HANGER; W. Gieth and J. Peters, Newark, N. J. App. filed Oct. 13, 1898. Device intended to take the weight of the lamp off the rope while the lamp is in its burning position. It comprises a hanger box having an open bottom and inwardly projecting hook shaped



No. 623,352.—Duplex Switch for Telephones.

ribs on opposite sides, and a suspending link having an approximately spherical enlarged end engaging the ribs.

623,393. ELECTRIC CURRENT CONTROLLER; J. B. Breeding, San Antonio, Texas. App. filed Aug. 13, 1898. A resistance device intended to go into the socket of an incandescent lamp, for controlling the amount of illumination the lamp shall give. A number of resistance blocks are arranged in the form of a cylinder and connected in series; the shifting key cuts the blocks into and out of circuit.

623,437. TELEPHONE SWITCHBOARD CIRCUIT; E. H. Smythe, Freeport, Ill. App. filed Feb. 23, 1898. The invention provides means whereby magneto-generator circuits and automatic signaling-circuits having one or more substations in circuit can be interconnected at the same switchboard table and with the same pairs of linking or switching cords and plugs that are used to unite substation circuits of the same kind, so that the connecting or supervisory signals are readily operated with every possible combination of connections and without requiring switch cords and plugs of diverse character.

623,441. AUTOMATIC FIRE AND BURGLAR ALARM; H. E. Thompson, Cameron, N. C. App. filed April 16, 1898. The organization comprises an electric bell in a shunt circuit to an easily fusible and low resistance conductor; the resistance of the bell magnet is purposely high and is so proportioned that an increase of current will cause the bell to ring; automatic means are provided by which when the fuse breaks and the bell is alone in circuit, the diminished current caused thereby partially de-energizes a relay magnet. The local circuit including an electric bell, is thereby closed and the bell rings in the central office. The operator throws in additional battery sufficient to ring the bells in all of the rooms protected.

623,444. ELECTRIC RAILWAY SIGNALING DEVICE; D. Valentine, Brocton, Mass. App. filed Sept. 23, 1898. A rod carrying a disc signal is attached to a solenoid core. When the solenoid acts the disc is twisted a quarter turn by means of a spiral groove in the rod in engagement with a fixed pin. The signal is applied in an automatic block system controlled by the moving trains.

623,480 ELECTRIC CIGAR LIGHTER; W. F. Kessler, Auburn, Ind. App. filed Oct. 17, 1898. A horizontally arranged shell is provided with a blaze opening in the upper face and with a wick and oil supply, means being furnished for throwing the ignition spark within the shell.